

Namespace BelNytheraSeiche.TrieDictionary

Classes

[AARecordStore](#)

A concrete implementation of [BinaryTreeRecordStore](#) that uses a self-balancing AA tree.

[AVLTreeRecordStore](#)

A concrete implementation of [BinaryTreeRecordStore](#) that uses a self-balancing AVL tree.

[BasicRecordStore](#)

An abstract base class for key-value record stores.

[BasicRecordStore.Record](#)

Represents a single node in a linked list of records.

[BasicRecordStore.RecordAccess](#)

Provides access to and manages a linked list of [BasicRecordStore.Record](#) objects.

[BasicRecordStore.SerializationOptions](#)

Provides options to control the serialization process for key-value record stores.

[BinaryTreeRecordStore](#)

An abstract base class for record stores that use a binary search tree to organize records.

[BitSet](#)

Provides a mutable bit set for efficiently building large bit vectors.

[BitwiseVectorDictionary](#)

A concrete implementation of [KeyRecordDictionary](#) that uses a high-performance, array-based trie structure.

[DirectedAcyclicGraphDictionary](#)

A concrete implementation of [KeyRecordDictionary](#) that uses a Directed Acyclic Word Graph (DAWG).

[DoubleArrayDictionary](#)

A concrete implementation of [KeyRecordDictionary](#) that uses a mutable Double-Array trie structure.

[HashMapRecordStore](#)

A concrete implementation of [BasicRecordStore](#) that uses a hash map as its underlying data structure.

[ImmutableBitSet](#)

Represents a read-only, immutable bit set.

[KeyRecordDictionary](#)

An abstract base class for advanced key-record dictionaries.

[KeyRecordDictionary.SerializationOptions](#)

Provides options to control the serialization process for dictionary data structures.

[KeyRecordDictionary.StringSpecialized](#)

Provides a string-specialized wrapper around an [KeyRecordDictionary.IKeyAccess](#) instance, simplifying operations by handling string-to-byte encoding and decoding.

[LevelOrderBitsDictionary](#)

An abstract base class for read-only, trie-based dictionaries that are constructed in level-order.

[LoudsDictionary](#)

A concrete implementation of [KeyRecordDictionary](#) that uses a memory-efficient LOUDS (Level-Order Unary Degree Sequence) trie.

[PrimitiveRecordStore](#)

Provides a low-level, memory-efficient data store for variable-length byte records.

[PrimitiveRecordStore.Record](#)

Represents a handle to a single record within the store.

[PrimitiveRecordStore.RecordAccess](#)

Provides access to a linked list of records within a [PrimitiveRecordStore](#).

[PrimitiveRecordStore.SerializationOptions](#)

Provides options to control the serialization process for data store.

[RankSelectBitSet](#)

An immutable bit set optimized for high-performance Rank and Select operations.

[ScapegoatTreeRecordStore](#)

A concrete implementation of [BinaryTreeRecordStore](#) that uses a self-balancing Scapegoat tree.

[TreapRecordStore](#)

A concrete implementation of [BinaryTreeRecordStore](#) that uses a Treap.

[ValueBuffer<T>](#)

Represents a buffer for value types, implemented using a list of array chunks.

[Xoroshiro128PlusPlus](#)

Represents a 64-bit pseudo-random number generator based on the xoroshiro128++ algorithm.

[Xoshiro256PlusPlus](#)

Represents a 64-bit pseudo-random number generator based on the xoshiro256++ algorithm.

Interfaces

[KeyRecordDictionary.IKeyAccess](#)

Defines the primary public contract for all key-based operations within the dictionary.

[KeyRecordDictionary.IRecord](#)

Defines a public contract for a single data record.

[KeyRecordDictionary.IRecordAccess](#)

Defines a public contract for accessing and managing a list of records associated with a single key.

Enums

[KeyRecordDictionary.SearchDirectionType](#)

Specifies the direction for key matching and sorting operations.

Class AATreeRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [BinaryTreeRecordStore](#) that uses a self-balancing AA tree.

```
public sealed class AATreeRecordStore : BinaryTreeRecordStore, ICloneable
```

Inheritance

[object](#) ↗ ← [BasicRecordStore](#) ← [BinaryTreeRecordStore](#) ← AATreeRecordStore

Implements

[ICloneable](#) ↗

Inherited Members

[BinaryTreeRecordStore.Clear\(\)](#) , [BinaryTreeRecordStore.Contains\(int\)](#) ,
[BinaryTreeRecordStore.GetRecordAccess\(int, out bool\)](#) ,
[BinaryTreeRecordStore.TryGetRecordAccess\(int, out BasicRecordStore.RecordAccess\)](#) ,
[BinaryTreeRecordStore.Enumerate\(\)](#) , [BinaryTreeRecordStore.PrintTree\(TextWriter\)](#) ,
[BasicRecordStore.Serialize<T>\(T, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, string, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, Stream, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Deserialize<T>\(byte\[\]\)](#) , [BasicRecordStore.Deserialize<T>\(string\)](#) ,
[BasicRecordStore.Deserialize<T>\(Stream\)](#) , [BasicRecordStore.Add\(int\)](#) ,
[BasicRecordStore.GetRecordAccess\(int\)](#) , [object.Equals\(object\)](#) ↗ , [object.Equals\(object, object\)](#) ↗ ,
[object.GetHashCode\(\)](#) ↗ , [object.GetType\(\)](#) ↗ , [object.ReferenceEquals\(object, object\)](#) ↗ ,
[object.ToString\(\)](#) ↗

Remarks

This class uses an AA tree, a variation of a Red-Black tree, to maintain balance. It simplifies the rebalancing logic by using two core operations, Skew and Split, to handle insertions and deletions efficiently.

Serialization Limits: The binary serialization format for this class imposes certain constraints on the data. Exceeding these limits will result in an [InvalidOperationException](#) ↗ during serialization.

- **Max Records per List:** A single identifier can have a maximum of 16,777,215 records in its linked list.
- **Max Record Content Size:** The [Content](#) byte array of any single record cannot exceed 65,535 bytes.

Methods

Clone()

Creates a deep copy of the [AATreeRecordStore](#).

```
public object Clone()
```

Returns

[object](#)

A new [AATreeRecordStore](#) instance with the same structure and record data as the original.

Remarks

The method creates a new tree and copies all records, ensuring that the new store is independent of the original.

Deserialize(Stream)

Deserializes an [AATreeRecordStore](#) from a stream.

```
public static AATreeRecordStore Deserialize(Stream stream)
```

Parameters

[stream](#) [Stream](#)

The stream to read the serialized data from.

Returns

[AATreeRecordStore](#)

A new instance of [AATreeRecordStore](#) reconstructed from the stream.

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidOperationException](#)

The stream data is corrupted, in an unsupported format, or contains invalid values.

IsBalanced()

Overrides the base method to check if the tree conforms to the specific balancing rules of an AA tree.

```
public override bool IsBalanced()
```

Returns

[bool](#)

true if the tree satisfies all tree invariants; otherwise, false.

Remarks

This method validates the level-based properties that define a valid tree.

Remove(int)

Removes the node with the specified identifier from the tree, performing rebalancing operations as necessary.

```
public override void Remove(int identifier)
```

Parameters

`identifier` [int](#)

The identifier of the node to remove.

Exceptions

[ArgumentOutOfRangeException](#)

`identifier` is [MinValue](#).

Serialize(AATreeRecordStore, Stream, SerializationOptions?)

Serializes the entire state of the tree store into a stream.

```
public static void Serialize(AATreeRecordStore store, Stream stream,  
BasicRecordStore.SerializationOptions? options = null)
```

Parameters

store [AATreeRecordStore](#)

The [AATreeRecordStore](#) instance to serialize.

stream [Stream](#)

The stream to write the serialized data to.

options [BasicRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is specific to this tree implementation, using Brotli compression and an XxHash32 checksum for data integrity.

Exceptions

[ArgumentNullException](#)

store or **stream** is null.

Class AVLTreeRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [BinaryTreeRecordStore](#) that uses a self-balancing AVL tree.

```
public sealed class AVLTreeRecordStore : BinaryTreeRecordStore, ICloneable
```

Inheritance

[object](#) ↗ ← [BasicRecordStore](#) ← [BinaryTreeRecordStore](#) ← AVLTreeRecordStore

Implements

[ICloneable](#) ↗

Inherited Members

[BinaryTreeRecordStore.Clear\(\)](#) , [BinaryTreeRecordStore.Contains\(int\)](#) ,
[BinaryTreeRecordStore.GetRecordAccess\(int, out bool\)](#) ,
[BinaryTreeRecordStore.TryGetRecordAccess\(int, out BasicRecordStore.RecordAccess\)](#) ,
[BinaryTreeRecordStore.Enumerate\(\)](#) , [BinaryTreeRecordStore.IsBalanced\(\)](#) ,
[BinaryTreeRecordStore.PrintTree\(TextWriter\)](#) ,
[BasicRecordStore.Serialize<T>\(T, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, string, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, Stream, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Deserialize<T>\(byte\[\]\)](#) , [BasicRecordStore.Deserialize<T>\(string\)](#) ,
[BasicRecordStore.Deserialize<T>\(Stream\)](#) , [BasicRecordStore.Add\(int\)](#) ,
[BasicRecordStore.GetRecordAccess\(int\)](#) , [object.Equals\(object\)](#) ↗ , [object.Equals\(object, object\)](#) ↗ ,
[object.GetHashCode\(\)](#) ↗ , [object.GetType\(\)](#) ↗ , [object.ReferenceEquals\(object, object\)](#) ↗ ,
[object.ToString\(\)](#) ↗

Remarks

This class provides efficient key-based record lookups, insertions, and deletions by maintaining the balance of the tree according to AVL rules, ensuring logarithmic time complexity for these operations.

Serialization Limits: The binary serialization format for this class imposes certain constraints on the data. Exceeding these limits will result in an [InvalidOperationException](#) ↗ during serialization.

- **Max Records per List:** A single identifier can have a maximum of 16,777,215 records in its linked list.
- **Max Record Content Size:** The [Content](#) byte array of any single record cannot exceed 65,535 bytes.

Methods

Clone()

Creates a deep copy of the [AVLTreeRecordStore](#).

```
public object Clone()
```

Returns

[object](#)

A new [AVLTreeRecordStore](#) instance with the same structure and record data as the original.

Remarks

The method creates a new tree and copies all records, ensuring that the new store is independent of the original.

Deserialize(Stream)

Deserializes an [AVLTreeRecordStore](#) from a stream.

```
public static AVLTreeRecordStore Deserialize(Stream stream)
```

Parameters

[stream](#) [Stream](#)

The stream to read the serialized data from.

Returns

[AVLTreeRecordStore](#)

A new instance of [AVLTreeRecordStore](#) reconstructed from the stream.

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidDataException](#)

The stream data is corrupted, in an unsupported format, or contains invalid values.

Remove(int)

Removes the node with the specified identifier from the tree, performing rebalancing rotations as necessary to maintain the tree's balance.

```
public override void Remove(int identifier)
```

Parameters

`identifier` [int](#)

The identifier of the node to remove.

Exceptions

[ArgumentOutOfRangeException](#)

`identifier` is [MinValue](#).

Serialize(AVLTreeRecordStore, Stream, SerializationOptions?)

Serializes the entire state of the tree store into a stream.

```
public static void Serialize(AVLTreeRecordStore store, Stream stream,  
BasicRecordStore.SerializationOptions? options = null)
```

Parameters

`store` [AVLTreeRecordStore](#)

The [AVLTreeRecordStore](#) instance to serialize.

`stream` [Stream](#)

The stream to write the serialized data to.

`options` [BasicRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is specific to this tree implementation, using Brotli compression and an XxHash32 checksum for data integrity.

Exceptions

[ArgumentNullException](#)

`store` or `stream` is null.

Class BasicRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

An abstract base class for key-value record stores.

```
public abstract class BasicRecordStore
```

Inheritance

[object](#) ← BasicRecordStore

Derived

[BinaryTreeRecordStore](#), [HashMapRecordStore](#)

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This class defines a common interface for record manipulation (add, remove, enumerate, etc.) and provides a generic, reflection-based serialization mechanism that dispatches to the static methods of the concrete derived class.

Methods

Add(int)

Adds a record with the specified identifier, or returns false if it already exists.

```
public virtual bool Add(int identifier)
```

Parameters

identifier [int](#)

The identifier of the record to add.

Returns

bool ↗

true if a new record was added; false if a record with that identifier already existed.

Clear()

When overridden in a derived class, removes all records from the store.

```
public virtual void Clear()
```

Contains(int)

When overridden in a derived class, determines whether a record with the specified identifier exists.

```
public virtual bool Contains(int identifier)
```

Parameters

identifier int ↗

The identifier to locate.

Returns

bool ↗

true if a record with the specified identifier is found; otherwise, false.

Deserialize<T>(byte[])

Deserializes a store from a byte array.

```
public static T Deserialize<T>(byte[] data) where T : BasicRecordStore
```

Parameters

data [byte\[\]](#)

The byte array containing the serialized data.

Returns

T

A new instance of **T**.

Type Parameters

T

The concrete type of the record store to deserialize, which must have a public static [Deserialize\(Stream\)](#) method.

Remarks

This static method uses reflection to invoke the static [Deserialize\(Stream\)](#) method on the specified type **T**.

Exceptions

[ArgumentNullException](#)

data is null.

Deserialize<T>(Stream)

Deserializes a store from a stream using reflection.

```
public static T Deserialize<T>(Stream stream) where T : BasicRecordStore
```

Parameters

stream [Stream](#)

The stream to read the serialized data from.

Returns

T

A new instance of T.

Type Parameters

T

The concrete type of the record store to deserialize, which must have a public static `Deserialize(Stream)` method.

Exceptions

[ArgumentNullException](#)

`stream` is null.

[NotSupportedException](#)

The type T does not have a public static `Deserialize(Stream)` method.

Deserialize<T>(string)

Deserializes a store from a file.

```
public static T Deserialize<T>(string file) where T : BasicRecordStore
```

Parameters

[file string](#)

The path of the file to read from.

Returns

T

A new instance of T.

Type Parameters

T

The concrete type of the record store to deserialize, which must have a public static `Deserialize(Stream)` method.

Remarks

This static method uses reflection to invoke the static `Deserialize(Stream)` method on the specified type `T`.

Exceptions

[ArgumentNullException](#)

`file` is null.

[ArgumentException](#)

`file` is empty or whitespace.

Enumerate()

When overridden in a derived class, returns an enumerator that iterates through all records in the store.

```
public virtual IEnumerable<(int, BasicRecordStore.RecordAccess)> Enumerate()
```

Returns

[IEnumerable](#)<(int, BasicRecordStore.RecordAccess)>

An `IEnumerable<T>` of tuples, each containing an identifier and its corresponding `BasicRecordStore.RecordAccess`.

GetRecordAccess(int)

Gets the accessor for a record with the specified identifier. If the record does not exist, it is created.

```
public virtual BasicRecordStore.RecordAccess GetRecordAccess(int identifier)
```

Parameters

identifier [int](#)

The identifier of the record to get or create.

Returns

[BasicRecordStore.RecordAccess](#)

A [BasicRecordStore.RecordAccess](#) for the found or newly created record.

GetRecordAccess(int, out bool)

When overridden in a derived class, gets the accessor for a record with the specified identifier, indicating if it was newly created.

```
public virtual BasicRecordStore.RecordAccess GetRecordAccess(int identifier, out  
bool createNew)
```

Parameters

identifier [int](#)

The identifier of the record to get or create.

createNew [bool](#)

When this method returns, contains true if a new record was created; otherwise, false.

Returns

[BasicRecordStore.RecordAccess](#)

A [BasicRecordStore.RecordAccess](#) for the found or newly created record.

Remove(int)

When overridden in a derived class, removes a record with the specified identifier.

```
public virtual void Remove(int identifier)
```

Parameters

identifier [int](#)

The identifier of the record to remove.

Serialize<T>(T, SerializationOptions?)

Serializes the specified store instance into a byte array.

```
public static byte[] Serialize<T>(T obj, BasicRecordStore.SerializationOptions? options = null) where T : BasicRecordStore
```

Parameters

obj T

The record store instance to serialize.

options [BasicRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Returns

[byte](#)[]

A byte array containing the serialized data.

Type Parameters

T

The concrete type of the record store, which must have a public static [Serialize\(T, Stream\)](#) method.

Remarks

This static method uses reflection to invoke the static [Serialize\(T, Stream\)](#) method on the actual type of [obj](#).

Exceptions

[ArgumentNullException](#)

obj is null.

Serialize<T>(T, Stream, SerializationOptions?)

Serializes the specified store instance into a stream using reflection.

```
public static void Serialize<T>(T obj, Stream stream, BasicRecordStore.SerializationOptions?  
options = null) where T : BasicRecordStore
```

Parameters

obj **T**

The record store instance to serialize.

stream [Stream](#)

The stream to write the serialized data to.

options [BasicRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Type Parameters

T

The concrete type of the record store, which must have a public static [Serialize\(T, Stream\)](#) method.

Exceptions

[ArgumentNullException](#)

obj or **stream** is null.

[NotSupportedException](#)

The type **T** does not have a public static [Serialize\(T, Stream\)](#) method.

Serialize<T>(T, string, SerializationOptions?)

Serializes the specified store instance to a file.

```
public static void Serialize<T>(T obj, string file, BasicRecordStore.SerializationOptions?  
options = null) where T : BasicRecordStore
```

Parameters

obj `T`

The record store instance to serialize.

file `string`

The path of the file to create.

options `BasicRecordStore.SerializationOptions`

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Type Parameters

`T`

The concrete type of the record store, which must have a public static `Serialize(T, Stream)` method.

Remarks

This static method uses reflection to invoke the static `Serialize(T, Stream)` method on the actual type of `obj`.

Exceptions

[ArgumentNullException](#)

`obj` or `file` is null.

[ArgumentException](#)

`file` is empty or whitespace.

TryGetRecordAccess(int, out RecordAccess?)

When overridden in a derived class, tries to get the accessor for a record with the specified identifier.

```
public virtual bool TryGetRecordAccess(int identifier, out BasicRecordStore.RecordAccess? access)
```

Parameters

identifier [int](#)

The identifier to locate.

access [BasicRecordStore.RecordAccess](#)

When this method returns, contains the [BasicRecordStore.RecordAccess](#) object if the identifier was found; otherwise, null.

Returns

[bool](#)

true if a record with the specified identifier was found; otherwise, false.

Class BasicRecordStore.Record

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Represents a single node in a linked list of records.

```
public sealed class BasicRecordStore.Record
```

Inheritance

[object](#) ← BasicRecordStore.Record

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Properties

Content

Gets or sets the byte array content of this record.

```
public byte[] Content { get; set; }
```

Property Value

[byte](#)[]

Exceptions

[ArgumentNullException](#)

The assigned value is null.

Next

Gets the next record in the list, or null if this is the last record.

```
public BasicRecordStore.Record? Next { get; }
```

Property Value

[BasicRecordStore.Record](#)

Methods

InsertAfter(ReadOnlySpan<byte>)

Inserts a new record with the specified content immediately after this record in the list.

```
public BasicRecordStore.Record InsertAfter(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record to insert.

Returns

[BasicRecordStore.Record](#)

The newly inserted [BasicRecordStore.Record](#).

InsertBefore(ReadOnlySpan<byte>)

Inserts a new record with the specified content immediately before this record in the list.

```
public BasicRecordStore.Record InsertBefore(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record to insert.

Returns

[BasicRecordStore.Record](#)

The newly inserted [BasicRecordStore.Record](#).

Remove()

Removes this record from the list it belongs to.

```
public void Remove()
```

Class BasicRecordStore.RecordAccess

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides access to and manages a linked list of [BasicRecordStore.Record](#) objects.

```
public sealed class BasicRecordStore.RecordAccess : IEnumerable<BasicRecordStore.Record>,  
IEnumerable
```

Inheritance

[object](#) ← BasicRecordStore.RecordAccess

Implements

[IEnumerable](#)<[BasicRecordStore.Record](#)>, [IEnumerable](#)

Inherited Members

[object.Equals\(object\)](#), [object.Equals\(object, object\)](#), [object.GetHashCode\(\)](#), [object.GetType\(\)](#),
[object.ReferenceEquals\(object, object\)](#), [object.ToString\(\)](#)

Remarks

This class implements [IEnumerable<T>](#) to allow easy iteration. The collection will throw an [InvalidOperationException](#) if modified during enumeration.

Properties

Identifier

Gets the identifier for the head of the linked list that this object accesses.

```
public int Identifier { get; }
```

Property Value

[int](#)

Methods

Add(ReadOnlySpan<byte>)

Adds a new record with the specified content to the end of the list.

```
public BasicRecordStore.Record Add(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record.

Returns

[BasicRecordStore.Record](#)

The newly added [BasicRecordStore.Record](#).

Clear()

Removes all records from the list.

```
public void Clear()
```

GetEnumerator()

Returns an enumerator that iterates through the records in the list.

```
public IEnumerator<BasicRecordStore.Record> GetEnumerator()
```

Returns

[IEnumerator<BasicRecordStore.Record>](#)

An enumerator for this record list.

Class BasicRecordStore.SerializationOptions

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides options to control the serialization process for key-value record stores.

```
public class BasicRecordStore.SerializationOptions
```

Inheritance

[object](#) ← BasicRecordStore.SerializationOptions

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Properties

CompressionLevel

Gets or sets the compression level to use for serialization.

```
public CompressionLevel CompressionLevel { get; set; }
```

Property Value

[CompressionLevel](#)

Remarks

Higher compression levels can result in smaller file sizes but may take longer to process. Defaults to [Fastest](#) for a balance of speed and size.

Default

Gets a singleton instance of [BasicRecordStore.SerializationOptions](#) with default values.

```
public static BasicRecordStore.SerializationOptions Default { get; }
```

Property Value

[BasicRecordStore.SerializationOptions](#)

Remarks

Use this property to avoid creating a new options object when default settings are sufficient.

Class BinaryTreeRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

An abstract base class for record stores that use a binary search tree to organize records.

```
public abstract class BinaryTreeRecordStore : BasicRecordStore
```

Inheritance

[object](#) ← [BasicRecordStore](#) ← [BinaryTreeRecordStore](#)

Derived

[AARecordStore](#), [AVLRecordStore](#), [ScapegoatRecordStore](#), [TreapRecordStore](#)

Inherited Members

[BasicRecordStore.Serialize<T>\(T, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, string, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, Stream, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Deserialize<T>\(byte\[\]\)](#) , [BasicRecordStore.Deserialize<T>\(string\)](#) ,
[BasicRecordStore.Deserialize<T>\(Stream\)](#) , [BasicRecordStore.Remove\(int\)](#) , [BasicRecordStore.Add\(int\)](#) ,
[BasicRecordStore.GetRecordAccess\(int\)](#) , [object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) ,
[object.GetHashCode\(\)](#) , [object.GetType\(\)](#) , [object.MemberwiseClone\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This class provides the core logic for searching, enumerating, and manipulating a binary tree structure where nodes are keyed by an integer identifier. Derived classes are expected to implement the specific insertion and balancing logic (e.g., for an AVL or Red-Black tree).

Methods

Clear()

Removes all nodes from the tree, effectively clearing the store.

```
public override void Clear()
```

Contains(int)

Determines whether a record with the specified identifier exists in the store.

```
public override bool Contains(int identifier)
```

Parameters

identifier [int](#)

The identifier to locate in the tree.

Returns

[bool](#)

true if a record with the specified identifier is found; otherwise, false.

Exceptions

[ArgumentOutOfRangeException](#)

identifier is equal to [MinValue](#), which is reserved.

Enumerate()

Returns an enumerator that iterates through all records in the store in ascending order of their identifiers.

```
public override IEnumerable<(int, BasicRecordStore.RecordAccess)> Enumerate()
```

Returns

[IEnumerable](#)<(int, [BasicRecordStore](#).[RecordAccess](#))>

An [IEnumerable](#)<[T](#)> of tuples, each containing the identifier and [BasicRecordStore](#).[RecordAccess](#) for a record.

Remarks

The enumeration is performed using an in-order traversal of the binary tree.

GetRecordAccess(int, out bool)

Gets the accessor for a record with the specified identifier. If the record does not exist, it is created.

```
public override BasicRecordStore.RecordAccess GetRecordAccess(int identifier, out  
bool createNew)
```

Parameters

identifier [int](#)

The identifier of the record to get or create.

createNew [bool](#)

When this method returns, contains true if a new record was created; otherwise, false.

Returns

[BasicRecordStore.RecordAccess](#)

A [BasicRecordStore.RecordAccess](#) for the found or newly created record.

IsBalanced()

Checks if the binary tree is balanced.

```
public virtual bool IsBalanced()
```

Returns

[bool](#)

true if the tree is balanced; otherwise, false.

Remarks

The base implementation validates if the tree is height-balanced, meaning the height difference between the left and right subtrees of any node is no more than 1 (consistent with AVL tree properties). Derived classes that implement different balancing strategies (e.g., Red-Black Trees) should override this method.

to provide their own validation logic. This can be a computationally expensive operation, primarily intended for debugging and validation.

PrintTree(TextWriter)

Prints a visual representation of the tree structure to the specified [TextWriter](#).

```
public void PrintTree(TextWriter textWriter)
```

Parameters

textWriter [TextWriter](#)

The [TextWriter](#) to output the tree structure to.

Exceptions

[ArgumentNullException](#)

textWriter is null.

TryGetRecordAccess(int, out RecordAccess?)

Tries to get the accessor for a record with the specified identifier.

```
public override bool TryGetRecordAccess(int identifier, out BasicRecordStore.RecordAccess? access)
```

Parameters

identifier [int](#)

The identifier to locate.

access [BasicRecordStore.RecordAccess](#)

When this method returns, contains the [BasicRecordStore.RecordAccess](#) object if the identifier was found; otherwise, null.

Returns

[bool](#)

true if a record with the specified identifier was found; otherwise, false.

Exceptions

[ArgumentOutOfRangeException](#)

identifier is equal to [MinValue](#), which is reserved.

Class BitSet

Namespace: [BelNytheraSeiche.TrieDictionary](#).

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides a mutable bit set for efficiently building large bit vectors.

```
public sealed class BitSet
```

Inheritance

[object](#) ← BitSet

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Constructors

BitSet(int)

Provides a mutable bit set for efficiently building large bit vectors.

```
public BitSet(int arrayAlignment = 65536)
```

Parameters

arrayAlignment [int](#)

The alignment size for the internal buffer chunks. Must be a power of 2. Defaults to 65536.

Properties

ArrayAlignment

Gets the alignment size used by the internal buffer.

```
public int ArrayAlignment { get; }
```

Property Value

[int](#)

Methods

Add(bool)

Adds a bit to the end of the bit set.

```
public void Add(bool bit)
```

Parameters

[bit](#) [bool](#)

The bit to add ([true](#) for 1, [false](#) for 0).

Get(int)

Gets the bit value at the specified index.

```
public bool Get(int index)
```

Parameters

[index](#) [int](#)

The zero-based index of the bit to get.

Returns

[bool](#)

The bit value ([true](#) for 1, [false](#) for 0) at the specified index.

Exceptions

[ArgumentOutOfRangeException](#)

`index` is less than 0 or greater than or equal to the number of bits in the set.

ToImmutable()

Creates an immutable, read-only version of this bit set.

```
public ImmutableBitSet ToImmutable()
```

Returns

[ImmutableBitSet](#)

A new [ImmutableBitSet](#) containing the current data.

ToImmutable(BitSet)

Creates an immutable, read-only version of a specified [BitSet](#).

```
public static ImmutableBitSet ToImmutable(BitSet bitSet)
```

Parameters

`bitSet` [BitSet](#)

The mutable bit set to convert.

Returns

[ImmutableBitSet](#)

A new [ImmutableBitSet](#) containing the data from the provided bit set.

Exceptions

[ArgumentNullException](#)

`bitSet` is null.

ToRankSelect(BitSet, bool)

Creates an immutable version of a specified [BitSet](#) optimized for high-performance Rank and Select operations.

```
public static RankSelectBitSet ToRankSelect(BitSet bitSet, bool createAuxDir = true)
```

Parameters

`bitSet` [BitSet](#)

The mutable bit set to convert.

`createAuxDir` [bool](#) ↗

A value indicating whether to immediately create the auxiliary directories required for fast Rank and Select operations.

Returns

[RankSelectBitSet](#)

A new [RankSelectBitSet](#) containing the data from the provided bit set and pre-calculated auxiliary indexes.

Remarks

If `createAuxDir` is set to `false`, this method is very fast, but the returned [RankSelectBitSet](#) will not be ready for Rank/Select operations until its auxiliary directories are created and set via the [SetAuxDir\(\)](#) method. If set to `true` (the default), the auxiliary directories are created during this call, which takes more processing time but results in a fully initialized and ready-to-use object.

Exceptions

[ArgumentNullException](#) ↗

`bitSet` is null.

ToRankSelect(bool)

Creates an immutable version of a specified [BitSet](#), optimized for high-performance Rank and Select operations.

```
public RankSelectBitSet ToRankSelect(bool createAuxDir = true)
```

Parameters

[createAuxDir](#) [bool](#) ↗

A value indicating whether to immediately create the auxiliary directories required for fast Rank and Select operations.

Returns

[RankSelectBitSet](#)

A new [RankSelectBitSet](#) containing the data from the provided bit set and pre-calculated auxiliary indexes.

Remarks

If [createAuxDir](#) is set to [false](#), this method is very fast, but the returned [RankSelectBitSet](#) will not be ready for Rank/Select operations until its auxiliary directories are created and set via the [SetAuxDir\(\)](#) method. If set to [true](#) (the default), the auxiliary directories are created during this call, which takes more processing time but results in a fully initialized and ready-to-use object.

Class BitwiseVectorDictionary

Namespace: [BelNytheraSeiche.TrieDictionary](#).

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [KeyRecordDictionary](#) that uses a high-performance, array-based trie structure.

```
public abstract class BitwiseVectorDictionary : LevelOrderBitsDictionary,  
KeyRecordDictionary.IKeyAccess
```

Inheritance

[object](#) ↗ ← [KeyRecordDictionary](#) ← [LevelOrderBitsDictionary](#) ← BitwiseVectorDictionary

Implements

[KeyRecordDictionary.IKeyAccess](#)

Inherited Members

[LevelOrderBitsDictionary.AsStringSpecialized\(Encoding\)](#) ,
[LevelOrderBitsDictionary.GetRecordAccess\(int, bool\)](#) ,
[LevelOrderBitsDictionary.Contains\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchExactly\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchCommonPrefix\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchLongestPrefix\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchByPrefix\(ReadOnlySpan<byte>, bool\)](#) ,
[LevelOrderBitsDictionary.EnumerateAll\(bool\)](#) ,
[LevelOrderBitsDictionary.SearchWildcard\(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool\)](#) ,
[LevelOrderBitsDictionary.FindFirst\(out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindLast\(out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindNext\(int, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindNext\(ReadOnlySpan<byte>, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindPrevious\(int, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindPrevious\(ReadOnlySpan<byte>, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.TryGetKey\(int, out byte\[\]\)](#) , [LevelOrderBitsDictionary.GetKey\(int\)](#) ,
[LevelOrderBitsDictionary.Add\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.TryAdd\(ReadOnlySpan<byte>, out int\)](#) , [LevelOrderBitsDictionary.Remove\(int\)](#) ,
[LevelOrderBitsDictionary.Remove\(ReadOnlySpan<byte>\)](#) , [KeyRecordDictionary.SearchDirection](#) ,
[KeyRecordDictionary.Additional1](#) , [KeyRecordDictionary.Additional2](#) ,
[KeyRecordDictionary.Create<T>\(KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Create<T>\(IEnumerable<byte\[\]>, KeyRecordDictionary.SearchDirectionType\)](#) ,

[KeyRecordDictionary.Create<T>\(IEnumerable<string>, Encoding, KeyRecordDictionary.SearchDirectionType\)](#),
[KeyRecordDictionary.Serialize<T>\(T, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Serialize<T>\(T, string, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Serialize<T>\(T, Stream, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Deserialize<T>\(byte\[\]\)](#), [KeyRecordDictionary.Deserialize<T>\(string\)](#),
[KeyRecordDictionary.Deserialize<T>\(Stream\)](#), [object.Equals\(object\) ↴](#), [object.Equals\(object, object\) ↴](#),
[object.GetHashCode\(\) ↴](#), [object.GetType\(\) ↴](#), [object.MemberwiseClone\(\) ↴](#),
[object.ReferenceEquals\(object, object\) ↴](#), [object.ToString\(\) ↴](#)

Remarks

This class represents a trie data structure that is flattened into a series of arrays using a level-order (breadth-first) build process. The tree's topology is stored using integer arrays for parent/child relationships, while a bit vector is used to mark terminal nodes. This approach prioritizes lookup performance and a relatively straightforward implementation over the extreme memory compactness of structures like LOUDS.

Important Usage Notes:

- **Read-Only Structure:** The dictionary is built once from a collection of keys and is effectively read-only afterward. Key addition and removal operations are not supported and will throw a [Not SupportedException ↴](#).
- **Key Reconstruction:** Getting a key by its identifier requires traversing the structure from a node up to the root.

Methods

Create(IEnumerable<byte[]>, SearchDirectionType)

Creates a new [BitwiseVectorDictionary](#) from a collection of keys.

```
public static BitwiseVectorDictionary Create(IEnumerable<byte[]> keys,  
    KeyRecordDictionary.SearchDirectionType searchDirection = SearchDirectionType.LTR)
```

Parameters

keys [IEnumerable<byte\[\]>](#)

An enumerable collection of byte arrays to use as the initial keys. The collection does not need to be pre-sorted. Duplicate keys are permitted, but only the first occurrence will be added. The collection

must not contain any elements that are null or empty byte array.

searchDirection [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Returns

[BitwiseVectorDictionary](#)

A new, optimized, and read-only [BitwiseVectorDictionary](#) instance.

Remarks

The input keys are sorted and used to construct the Bitwise-Vector trie representation.

Exceptions

[ArgumentNullException](#)

keys is null.

Deserialize(Stream)

Deserializes a dictionary from a stream.

```
public static BitwiseVectorDictionary Deserialize(Stream stream)
```

Parameters

stream [Stream](#)

The stream to read the serialized data from.

Returns

[BitwiseVectorDictionary](#)

A new instance of [BitwiseVectorDictionary](#).

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidDataException](#)

The stream data is corrupted or in an unsupported format.

Serialize(BitwiseVectorDictionary, Stream, SerializationOptions?)

Serializes the state of the dictionary into a stream.

```
public static void Serialize(BitwiseVectorDictionary dictionary, Stream stream,  
    KeyRecordDictionary.SerializationOptions? options = null)
```

Parameters

`dictionary` [BitwiseVectorDictionary](#)

The dictionary instance to serialize.

`stream` [Stream](#)

The stream to write the serialized data to.

`options` [KeyRecordDictionary.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is a custom binary format specific to this Bitwise-Vector implementation.

Exceptions

[ArgumentNullException](#)

`dictionary` or `stream` is null.

Class DirectedAcyclicGraphDictionary

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [KeyRecordDictionary](#) that uses a Directed Acyclic Word Graph (DAWG).

```
public abstract class DirectedAcyclicGraphDictionary : KeyRecordDictionary,  
    KeyRecordDictionary.IKeyAccess
```

Inheritance

[object](#) ← [KeyRecordDictionary](#) ← [DirectedAcyclicGraphDictionary](#)

Implements

[KeyRecordDictionary.IKeyAccess](#)

Inherited Members

[KeyRecordDictionary.SearchDirection](#) , [KeyRecordDictionary.Additional1](#) ,
[KeyRecordDictionary.Additional2](#) ,
[KeyRecordDictionary.Create<T>\(KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Create<T>\(IEnumerable<byte\[\]>, KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Create<T>\(IEnumerable<string>, Encoding,](#)
[KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Serialize<T>\(T, KeyRecordDictionary.SerializationOptions\)](#) ,
[KeyRecordDictionary.Serialize<T>\(T, string, KeyRecordDictionary.SerializationOptions\)](#) ,
[KeyRecordDictionary.Serialize<T>\(T, Stream, KeyRecordDictionary.SerializationOptions\)](#) ,
[KeyRecordDictionary.Deserialize<T>\(byte\[\]\)](#) , [KeyRecordDictionary.Deserialize<T>\(string\)](#) ,
[KeyRecordDictionary.Deserialize<T>\(Stream\)](#) , [object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) ,
[object.GetHashCode\(\)](#) , [object.GetType\(\)](#) , [object.MemberwiseClone\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This class stores keys in a DAWG, which is a data structure that compresses a standard Trie by merging common prefixes and suffixes to reduce redundancy.

Important Usage Notes:

- **Read-Only Structure:** The dictionary is built once from a collection of keys and is effectively read-only afterward. The [Add](#) and [Remove](#) operations for keys are not supported and will throw a [Not SupportedException](#).

Methods

Add(ReadOnlySpan<byte>)

This operation is not supported. The dictionary is read-only after creation.

```
public int Add(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan<byte>](#)

Returns

[int](#)

Exceptions

[NotSupportedException](#)

Always thrown.

AsStringSpecialized(Encoding?)

Returns a string-specialized wrapper for the dictionary's key access interface.

```
public KeyRecordDictionary.StringSpecialized AsStringSpecialized(Encoding? encoding = null)
```

Parameters

encoding [Encoding](#)

The encoding to use for string conversions. Defaults to UTF-8.

Returns

[KeyRecordDictionary.StringSpecialized](#)

A new [KeyRecordDictionary.StringSpecialized](#) instance providing string-based access to the dictionary.

Contains(ReadOnlySpan<byte>)

Determines whether the specified key exists in the graph.

```
public virtual bool Contains(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan<byte>](#)

The key to locate.

Returns

[bool](#)

true if the key is found; otherwise, false.

Create(IEnumerable<byte[]>, SearchDirectionType)

Creates a new [DirectedAcyclicGraphDictionary](#) from a collection of keys.

```
public static DirectedAcyclicGraphDictionary Create(IEnumerable<byte[]> keys,  
KeyRecordDictionary.SearchDirectionType searchDirection = SearchDirectionType.LTR)
```

Parameters

keys [IEnumerable<byte\[\]>](#)

An enumerable collection of byte arrays to use as the initial keys. The collection does not need to be pre-sorted. Duplicate keys are permitted, but only the first occurrence will be added. The collection must not contain any elements that are null or empty byte array.

searchDirection [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Returns

[DirectedAcyclicGraphDictionary](#)

A new, optimized, and read-only [DirectedAcyclicGraphDictionary](#) instance.

Remarks

The input keys are sorted and used to build a minimal, compressed graph structure.

Exceptions

[ArgumentNullException](#)

`keys` is null.

Deserialize(Stream)

Deserializes a dictionary from a stream.

```
public static DirectedAcyclicGraphDictionary Deserialize(Stream stream)
```

Parameters

`stream` [Stream](#)

The stream to read the serialized data from.

Returns

[DirectedAcyclicGraphDictionary](#)

A new instance of [DirectedAcyclicGraphDictionary](#).

Exceptions

[InvalidDataException](#)

The stream data is corrupted or in an unsupported format.

[ArgumentNullException](#)

`stream` is null.

EnumerateAll(bool)

Enumerates all keys in the dictionary in lexicographical order.

```
public virtual IEnumerable<(int, byte[])> EnumerateAll(bool reverse = false)
```

Parameters

`reverse` [bool](#)

If true, returns keys in reverse lexicographical order.

Returns

[IEnumerable](#)<(int, byte[])>

An enumerable collection of all (identifier, key) tuples.

FindFirst(out int, out byte[])

Finds the first key in the dictionary in lexicographical order.

```
public virtual bool FindFirst(out int identifier, out byte[] key)
```

Parameters

`identifier` [int](#)

When this method returns, the identifier of the first key.

`key` [byte](#)[]

When this method returns, the first key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindLast(out int, out byte[])

Finds the last key in the dictionary in lexicographical order.

```
public virtual bool FindLast(out int identifier, out byte[] key)
```

Parameters

identifier [int](#)

When this method returns, the identifier of the last key.

key [byte](#)[]

When this method returns, the last key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindNext(int, out int, out byte[])

Finds the next key in lexicographical order after the specified identifier.

```
public virtual bool FindNext(int currentIdentifier, out int foundIdentifier, out
byte[] foundKey)
```

Parameters

currentIdentifier [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [byte](#)[]

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindNext(ReadOnlySpan<byte>, out int, out byte[])

Finds the next key in lexicographical order after the specified key.

```
public virtual bool FindNext(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out
byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan](#)<[byte](#)>

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [byte](#)[]

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindPrevious(int, out int, out byte[])

Finds the previous key in lexicographical order before the specified identifier.

```
public virtual bool FindPrevious(int currentIdentifier, out int foundIdentifier, out
byte[] foundKey)
```

Parameters

currentIdentifier [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [byte](#)[]

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

FindPrevious(ReadOnlySpan<byte>, out int, out byte[])

Finds the previous key in lexicographical order before the specified key.

```
public virtual bool FindPrevious(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan](#)<[byte](#)>

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [byte](#)[]

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

GetKey(int)

Gets the key associated with the specified identifier.

```
public virtual byte[] GetKey(int identifier)
```

Parameters

[identifier](#) [int](#)

The identifier of the key to get.

Returns

[byte](#)[]

The key as a byte array.

Exceptions

[ArgumentException](#)

The specified identifier does not exist.

GetRecordAccess(int, bool)

Gets an accessor for the list of records associated with a given key identifier.

```
public KeyRecordDictionary.IRecordAccess GetRecordAccess(int identifier, bool isTransient  
= false)
```

Parameters

[identifier](#) [int](#)

The identifier of the key whose records are to be accessed. This must be a valid key identifier obtained from a search or add operation.

isTransient [bool](#) ↗

If true, accesses the transient (in-memory) record store; otherwise, accesses the persistent record store.

Returns

[KeyRecordDictionary.IRecordAccess](#)

An [KeyRecordDictionary.IRecordAccess](#) handle for the specified record list.

Remarks

Note that while new records can be added to a key's record list, new keys cannot be added to the dictionary itself after creation.

Exceptions

[ArgumentOutOfRangeException](#) ↗

identifier is negative.

[ArgumentException](#) ↗

The specified **identifier** is invalid or does not exist.

Remove(int)

This operation is not supported. The dictionary is read-only after creation.

```
public bool Remove(int identifier)
```

Parameters

identifier [int](#) ↗

Returns

[bool](#) ↗

Exceptions

[NotSupportedException](#)

Always thrown.

Remove(ReadOnlySpan<byte>)

This operation is not supported. The dictionary is read-only after creation.

```
public bool Remove(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan](#)<byte>

Returns

[bool](#)

Exceptions

[NotSupportedException](#)

Always thrown.

SearchByPrefix(ReadOnlySpan<byte>, bool)

Finds all keys that start with the given prefix.

```
public virtual IEnumerable<(int, byte[])> SearchByPrefix(ReadOnlySpan<byte> sequence, bool reverse = false)
```

Parameters

sequence [ReadOnlySpan](#)<byte>

The prefix to search for.

`reverse` `bool`

If true, returns results in reverse lexicographical order.

Returns

`IEnumerable<(int, byte[])>`

An enumerable collection of (identifier, key) tuples for all keys starting with the prefix.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchByPrefix\(ReadOnlySpan<byte>, bool\)](#).

SearchCommonPrefix(ReadOnlySpan<byte>)

Finds all keys in the dictionary that are prefixes of the given sequence.

```
public virtual IEnumerable<(int, byte[])> SearchCommonPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

`sequence` `ReadOnlySpan<byte>`

The sequence to search within.

Returns

`IEnumerable<(int, byte[])>`

An enumerable collection of (identifier, key) tuples for all matching prefixes.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchCommonPrefix\(ReadOnlySpan<byte>\)](#).

SearchExactly(ReadOnlySpan<byte>)

Searches for an exact match of the given sequence and returns its identifier.

```
public virtual int SearchExactly(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The key to search for.

Returns

[int](#)

The positive identifier for the key if found; otherwise, a non-positive value.

SearchLongestPrefix(ReadOnlySpan<byte>)

Finds the longest key in the dictionary that is a prefix of the given sequence.

```
public virtual (int, byte[]) SearchLongestPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The sequence to search within.

Returns

[\(int, byte\[\]\)](#)

An enumerable collection of (identifier, key) tuples for all matching prefixes.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchLongestPrefix\(ReadOnlySpan<byte>\)](#).

SearchWildcard(ReadOnlySpan<byte>, ReadOnlySpan<char>,

bool)

Performs a wildcard search for keys matching a pattern.

```
public virtual IEnumerable<(int, byte[])> SearchWildcard(ReadOnlySpan<byte> sequence,  
ReadOnlySpan<char> cards, bool reverse = false)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The byte sequence of the pattern.

cards [ReadOnlySpan<char>](#)

A sequence of characters ('?' for single, '*' for multiple wildcards) corresponding to the pattern.

reverse [bool](#)

If true, returns results in reverse order.

Returns

[IEnumerable<\(int, byte\[\]\)>](#)

An enumerable collection of matching (identifier, key) tuples.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchWildcard\(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool\)](#).

Serialize(DirectedAcyclicGraphDictionary, Stream, Serialization Options?)

Serializes the state of the dictionary into a stream.

```
public static void Serialize(DirectedAcyclicGraphDictionary dictionary, Stream stream,  
KeyRecordDictionary.SerializationOptions? options = null)
```

Parameters

dictionary [DirectedAcyclicGraphDictionary](#)

The dictionary instance to serialize.

stream [Stream](#)

The stream to write the serialized data to.

options [KeyRecordDictionary.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is a custom binary format specific to this graph implementation.

Exceptions

[ArgumentNullException](#)

dictionary or **stream** is null.

TryAdd(ReadOnlySpan<byte>, out int)

This operation is not supported. The dictionary is read-only after creation.

```
public bool TryAdd(ReadOnlySpan<byte> key, out int identifier)
```

Parameters

key [ReadOnlySpan](#)<[byte](#)>

identifier [int](#)

Returns

[bool](#)

Exceptions

[NotSupportedException](#)

Always thrown.

TryGetKey(int, out byte[])

Tries to get the key associated with the specified identifier.

```
public virtual bool TryGetKey(int identifier, out byte[] key)
```

Parameters

identifier [int](#)

The identifier of the key to get.

key [byte](#)[]

When this method returns, contains the key if found; otherwise, an empty array.

Returns

[bool](#)

true if the key was found; otherwise, false.

Class DoubleArrayDictionary

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [KeyRecordDictionary](#) that uses a mutable Double-Array trie structure.

```
public abstract class DoubleArrayDictionary : KeyRecordDictionary,  
    KeyRecordDictionary.IKeyAccess
```

Inheritance

[object](#) ← [KeyRecordDictionary](#) ← DoubleArrayDictionary

Implements

[KeyRecordDictionary.IKeyAccess](#)

Inherited Members

[KeyRecordDictionary.SearchDirection](#) , [KeyRecordDictionary.Additional1](#) ,
[KeyRecordDictionary.Additional2](#) ,
[KeyRecordDictionary.Create<T>\(KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Create<T>\(IEnumerable<byte\[\]>, KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Create<T>\(IEnumerable<string>, Encoding,](#)
[KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Serialize<T>\(T, KeyRecordDictionary.SerializationOptions\)](#) ,
[KeyRecordDictionary.Serialize<T>\(T, string, KeyRecordDictionary.SerializationOptions\)](#) ,
[KeyRecordDictionary.Serialize<T>\(T, Stream, KeyRecordDictionary.SerializationOptions\)](#) ,
[KeyRecordDictionary.Deserialize<T>\(byte\[\]\)](#) , [KeyRecordDictionary.Deserialize<T>\(string\)](#) ,
[KeyRecordDictionary.Deserialize<T>\(Stream\)](#) , [object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) ,
[object.GetHashCode\(\)](#) , [object.GetType\(\)](#) , [object.MemberwiseClone\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This class provides very fast key lookups by representing a trie data structure in two compact arrays ('BASE' and 'CHECK').

Important Usage Notes:

- **Mutable Structure:** Unlike the DAWG or LOUDS implementations, this dictionary is mutable. Keys can be added and removed after the initial creation.

- **Fragmentation:** Repeated additions and removals can lead to fragmentation of the internal arrays, which may degrade performance and increase memory usage over time. To eliminate fragmentation and optimize the structure, it is recommended to periodically rebuild the dictionary using the static [Compact\(DoubleArrayDictionary\)](#) method.

Methods

Add(ReadOnlySpan<byte>)

Adds a key to the dictionary. If the key already exists, its existing identifier is returned.

```
public virtual int Add(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan<byte>](#)

The key to add.

Returns

[int](#)

The identifier for the added or existing key.

Exceptions

[ArgumentException](#)

key is empty.

AsStringSpecialized(Encoding?)

Returns a string-specialized wrapper for the dictionary's key access interface.

```
public KeyRecordDictionary.StringSpecialized AsStringSpecialized(Encoding? encoding = null)
```

Parameters

[encoding](#) [Encoding](#)

The encoding to use for string conversions. Defaults to UTF-8.

Returns

[KeyRecordDictionary.StringSpecialized](#)

A new [KeyRecordDictionary.StringSpecialized](#) instance providing string-based access to the dictionary.

Clear()

Removes all keys and records from the dictionary and resets its internal state.

```
public void Clear()
```

Compact(DoubleArrayDictionary)

Rebuilds the dictionary to eliminate fragmentation and optimize its internal structure.

```
public static DoubleArrayDictionary Compact(DoubleArrayDictionary original)
```

Parameters

[original](#) [DoubleArrayDictionary](#)

The original, potentially fragmented dictionary to compact.

Returns

[DoubleArrayDictionary](#)

A new, compacted [DoubleArrayDictionary](#) instance containing the same keys and records.

Remarks

This method should be used when performance or memory usage degrades after a large number of additions and removals. It works by creating a new dictionary from the keys of the original, effectively rebuilding the internal arrays.

Important: The integer identifiers assigned to keys in the new, compacted dictionary will be different from those in the original. Any external references to the old identifiers will be invalid after compaction.

Exceptions

[ArgumentNullException](#)

`original` is null.

Contains(ReadOnlySpan<byte>)

Determines whether the specified key exists in the dictionary.

```
public virtual bool Contains(ReadOnlySpan<byte> key)
```

Parameters

`key` [ReadOnlySpan](#)<[byte](#)>

The key to locate.

Returns

[bool](#)

true if the key is found; otherwise, false.

Create(IEnumerable<byte[]>, SearchDirectionType)

Creates a new [DoubleArrayDictionary](#) from a collection of keys.

```
public static DoubleArrayDictionary Create(IEnumerable<byte[]> keys,  
KeyRecordDictionary.SearchDirectionType searchDirection = SearchDirectionType.LTR)
```

Parameters

`keys` [IEnumerable](#)<[byte](#)[]>

An enumerable collection of byte arrays to use as the initial keys. The collection does not need to be pre-sorted. Duplicate keys are permitted, but only the first occurrence will be added. The collection must not contain any elements that are null or empty byte array.

searchDirection [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Returns

[DoubleArrayDictionary](#)

A new, mutable [DoubleArrayDictionary](#) instance.

Exceptions

[ArgumentNullException](#)

keys is null.

Deserialize(Stream)

Deserializes a dictionary from a stream.

```
public static DoubleArrayDictionary Deserialize(Stream stream)
```

Parameters

stream [Stream](#)

The stream to read the serialized data from.

Returns

[DoubleArrayDictionary](#)

A new instance of [DoubleArrayDictionary](#).

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidDataException](#)

The stream data is corrupted or in an unsupported format.

EnumerateAll(bool)

Enumerates all keys in the dictionary in lexicographical order.

```
public virtual IEnumerable<(int, byte[])> EnumerateAll(bool reverse = false)
```

Parameters

`reverse` [bool](#)

If true, returns keys in reverse lexicographical order.

Returns

[IEnumerable](#) <(int, byte[])>

An enumerable collection of all (identifier, key) tuples.

FindFirst(out int, out byte[])

Finds the first key in the dictionary in lexicographical order.

```
public virtual bool FindFirst(out int identifier, out byte[] key)
```

Parameters

`identifier` [int](#)

When this method returns, the identifier of the first key.

`key` [byte](#)[]

When this method returns, the first key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindLast(out int, out byte[])

Finds the last key in the dictionary in lexicographical order.

```
public virtual bool FindLast(out int identifier, out byte[] key)
```

Parameters

[identifier](#) [int](#)

When this method returns, the identifier of the last key.

[key](#) [byte](#)[]

When this method returns, the last key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindNext(int, out int, out byte[])

Finds the next key in lexicographical order after the specified identifier.

```
public virtual bool FindNext(int currentIdentifier, out int foundIdentifier, out
byte[] foundKey)
```

Parameters

[currentIdentifier](#) [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [byte](#)[]

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindNext(ReadOnlySpan<byte>, out int, out byte[])

Finds the next key in lexicographical order after the specified key.

```
public virtual bool FindNext(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out  
byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan](#)<[byte](#)>

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [byte](#)[]

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindPrevious(int, out int, out byte[])

Finds the previous key in lexicographical order before the specified identifier.

```
public virtual bool FindPrevious(int currentIdentifier, out int foundIdentifier, out byte[] foundKey)
```

Parameters

currentIdentifier [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [byte](#)[]

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

FindPrevious(ReadOnlySpan<byte>, out int, out byte[])

Finds the previous key in lexicographical order before the specified key.

```
public virtual bool FindPrevious(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan](#)<[byte](#)>

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

[foundKey](#) `byte[]`

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

GetKey(int)

Gets the key associated with the specified identifier.

```
public virtual byte[] GetKey(int identifier)
```

Parameters

[identifier](#) `int`

The identifier of the key to get.

Returns

[byte\[\]](#)

The key as a byte array.

Exceptions

[ArgumentOutOfRangeException](#)

The specified identifier is out of the valid range.

[ArgumentException](#)

The specified identifier is invalid.

GetRecordAccess(int, bool)

Gets an accessor for the list of records associated with a given key identifier.

```
public KeyRecordDictionary.IRecordAccess GetRecordAccess(int identifier, bool isTransient  
= false)
```

Parameters

identifier [int](#)

The identifier of the key whose records are to be accessed. This must be a valid key identifier obtained from a search or add operation.

isTransient [bool](#)

If true, accesses the transient (in-memory) record store; otherwise, accesses the persistent record store.

Returns

[KeyRecordDictionary.IRecordAccess](#)

An [KeyRecordDictionary.IRecordAccess](#) handle for the specified record list.

Remarks

Note that while new records can be added to a key's record list, new keys cannot be added to the dictionary itself after creation.

Exceptions

[ArgumentException](#)

The specified **identifier** is invalid or does not exist.

Remove(int)

Removes a key and its associated records from the dictionary using its identifier.

```
public virtual bool Remove(int identifier)
```

Parameters

identifier [int](#)

The identifier of the key to remove.

Returns

[bool](#)

true if the key was found and removed; otherwise, false.

Remove(ReadOnlySpan<byte>)

Removes a key and its associated records from the dictionary.

```
public virtual bool Remove(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan](#)<[byte](#)>

The key to remove.

Returns

[bool](#)

true if the key was found and removed; otherwise, false.

SearchByPrefix(ReadOnlySpan<byte>, bool)

Finds all keys that start with the given prefix.

```
public virtual IEnumerable<(int, byte[])> SearchByPrefix(ReadOnlySpan<byte> sequence, bool reverse = false)
```

Parameters

`sequence ReadOnlySpan<byte>`

The prefix to search for.

`reverse bool`

If true, returns results in reverse lexicographical order.

Returns

`IEnumerable<\(int, byte\[\]>`

An enumerable collection of (identifier, key) tuples for all keys starting with the prefix.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchByPrefix\(ReadOnlySpan<byte>, bool\)](#).

SearchCommonPrefix(ReadOnlySpan<byte>)

Finds all keys in the dictionary that are prefixes of the given sequence.

```
public virtual IEnumerable<\(int, byte\[\]> SearchCommonPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

`sequence ReadOnlySpan<byte>`

The sequence to search within.

Returns

`IEnumerable<\(int, byte\[\]>`

An enumerable collection of (identifier, key) tuples for all matching prefixes.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchCommonPrefix\(ReadOnlySpan<byte>\)](#).

SearchExactly(ReadOnlySpan<byte>)

Searches for an exact match of the given sequence and returns its identifier.

```
public virtual int SearchExactly(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The key to search for.

Returns

[int](#)

The positive identifier for the key if found; otherwise, a non-positive value.

SearchLongestPrefix(ReadOnlySpan<byte>)

Finds the longest key in the dictionary that is a prefix of the given sequence.

```
public virtual (int, byte[]) SearchLongestPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The sequence to search within.

Returns

[\(int, byte\[\]\)](#)

A tuple containing the identifier and key of the longest matching prefix, or (-1, []) if no match is found.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchLongestPrefix\(ReadOnlySpan<byte>\)](#).

SearchWildcard(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool)

Performs a wildcard search for keys matching a pattern.

```
public virtual IEnumerable<(int, byte[])> SearchWildcard(ReadOnlySpan<byte> sequence,  
    ReadOnlySpan<char> cards, bool reverse = false)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The byte sequence of the pattern.

cards [ReadOnlySpan<char>](#)

A sequence of characters ('?' for single, '*' for multiple wildcards) corresponding to the pattern.

reverse [bool](#)

If true, returns results in reverse order.

Returns

[IEnumerable<\(int, byte\[\]\)>](#)

An enumerable collection of matching (identifier, key) tuples.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchWildcard\(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool\)](#).

Serialize(DoubleArrayDictionary, Stream, SerializationOptions?)

Serializes the state of the dictionary into a stream.

```
public static void Serialize(DoubleArrayDictionary dictionary, Stream stream,  
    KeyRecordDictionary.SerializationOptions? options = null)
```

Parameters

dictionary [DoubleArrayDictionary](#)

The dictionary instance to serialize.

stream [Stream](#)

The stream to write the serialized data to.

options [KeyRecordDictionary.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is a custom binary format specific to this Double-Array trie implementation.

Exceptions

[ArgumentNullException](#)

dictionary or **stream** is null.

TryAdd(ReadOnlySpan<byte>, out int)

Tries to add a key to the dictionary.

```
public virtual bool TryAdd(ReadOnlySpan<byte> key, out int identifier)
```

Parameters

key [ReadOnlySpan](#)<[byte](#)>

The key to add.

identifier [int](#)

When this method returns, contains the identifier for the new key. If the key already existed, this will be the existing identifier.

Returns

[bool](#)

true if the key was newly added; false if the key already existed.

Exceptions

[ArgumentException](#)

key is empty.

TryGetKey(int, out byte[])

Tries to get the key associated with the specified identifier.

```
public virtual bool TryGetKey(int identifier, out byte[] key)
```

Parameters

identifier [int](#)

The identifier of the key to get.

key [byte](#)[]

When this method returns, contains the key if found; otherwise, an empty array.

Returns

[bool](#)

true if the key was found; otherwise, false.

Class HashMapRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [BasicRecordStore](#) that uses a hash map as its underlying data structure.

```
public sealed class HashMapRecordStore : BasicRecordStore, ICloneable
```

Inheritance

[object](#) ← [BasicRecordStore](#) ← [HashMapRecordStore](#)

Implements

[ICloneable](#)

Inherited Members

[BasicRecordStore.Serialize<T>\(T, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, string, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, Stream, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Deserialize<T>\(byte\[\]\)](#) , [BasicRecordStore.Deserialize<T>\(string\)](#) ,
[BasicRecordStore.Deserialize<T>\(Stream\)](#) , [BasicRecordStore.Clear\(\)](#) , [BasicRecordStore.Add\(int\)](#) ,
[BasicRecordStore.GetRecordAccess\(int\)](#) , [object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) ,
[object.GetHashCode\(\)](#) , [object.GetType\(\)](#) , [object.ReferenceEquals\(object, object\)](#) ,
[object.ToString\(\)](#)

Remarks

This class uses a [Dictionary< TKey, TValue >](#) to store records. It provides fast, average-case O(1) time complexity for record lookups, additions, and removals. Unlike the tree-based stores, this implementation does not store or enumerate records in a sorted order.

Serialization Limits: The binary serialization format for this class imposes certain constraints on the data. Exceeding these limits will result in an [InvalidOperationException](#) during serialization.

- **Max Records per List:** A single identifier can have a maximum of 16,777,215 records in its linked list.
- **Max Record Content Size:** The [Content](#) byte array of any single record cannot exceed 65,535 bytes.

Constructors

HashMapRecordStore()

Initializes a new, empty instance of the [HashMapRecordStore](#) class.

```
public HashMapRecordStore()
```

Methods

Clone()

Creates a deep copy of the [HashMapRecordStore](#).

```
public object Clone()
```

Returns

[object](#)

A new [HashMapRecordStore](#) instance with the same keys and record data as the original.

Remarks

The method creates a new dictionary and copies all key-value pairs and their associated record lists, ensuring that the new store is independent of the original.

Contains(int)

Determines whether a record with the specified identifier exists in the hash map.

```
public override bool Contains(int identifier)
```

Parameters

identifier [int](#)

The identifier to locate.

Returns

[bool](#)

true if a record with the specified identifier is found; otherwise, false.

Deserialize(Stream)

Deserializes a [HashMapRecordStore](#) from a stream.

```
public static HashMapRecordStore Deserialize(Stream stream)
```

Parameters

stream [Stream](#)

The stream to read the serialized data from.

Returns

[HashMapRecordStore](#)

A new instance of [HashMapRecordStore](#) reconstructed from the stream.

Exceptions

[ArgumentNullException](#)

stream is null.

[InvalidDataException](#)

The stream data is corrupted, in an unsupported format, or contains invalid values.

Enumerate()

Returns an enumerator that iterates through all records in the store.

```
public override IEnumerable<(int, BasicRecordStore.RecordAccess)> Enumerate()
```

Returns

[IEnumerable<\(int, BasicRecordStore.RecordAccess\)>](#)

An [IEnumerable<T>](#) of tuples, each containing an identifier and its corresponding [BasicRecordStore.RecordAccess](#).

Remarks

The order of enumeration is not guaranteed to be sorted, as it depends on the internal implementation of the hash map.

GetRecordAccess(int, out bool)

Gets the accessor for a record's list of data. If an entry for the identifier does not exist, it is created.

```
public override BasicRecordStore.RecordAccess GetRecordAccess(int identifier, out  
    bool createNew)
```

Parameters

identifier [int](#)

The identifier of the record list.

createNew [bool](#)

When this method returns, contains true if a new entry was created; otherwise, false.

Returns

[BasicRecordStore.RecordAccess](#)

A [BasicRecordStore.RecordAccess](#) for the found or newly created record list.

Remove(int)

Removes the record (and its associated list of data) with the specified identifier from the hash map.

```
public override void Remove(int identifier)
```

Parameters

identifier [int](#)

The identifier of the record to remove.

Serialize(HashMapRecordStore, Stream, SerializationOptions?)

Serializes the entire state of the hash map store into a stream.

```
public static void Serialize(HashMapRecordStore store, Stream stream,  
BasicRecordStore.SerializationOptions? options = null)
```

Parameters

store [HashMapRecordStore](#)

The [HashMapRecordStore](#) instance to serialize.

stream [Stream](#)

The stream to write the serialized data to.

options [BasicRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is specific to this hash map implementation, using Brotli compression and an XxHash32 checksum for data integrity.

Exceptions

[ArgumentNullException](#)

store or **stream** is null.

TryGetRecordAccess(int, out RecordAccess?)

Tries to get the accessor for a record's list of data.

```
public override bool TryGetRecordAccess(int identifier, out BasicRecordStore.RecordAccess?  
access)
```

Parameters

identifier [int](#)

The identifier to locate.

access [BasicRecordStore.RecordAccess](#)

When this method returns, contains the [BasicRecordStore.RecordAccess](#) object if the identifier was found; otherwise, null.

Returns

[bool](#)

true if an entry with the specified identifier was found; otherwise, false.

Class ImmutableBitSet

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Represents a read-only, immutable bit set.

```
public class ImmutableBitSet
```

Inheritance

[object](#) ← ImmutableBitSet

Derived

[RankSelectBitSet](#)

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Constructors

ImmutableBitSet(ulong[], int)

Represents a read-only, immutable bit set.

```
public ImmutableBitSet(ulong[] buffer, int count)
```

Parameters

buffer [ulong](#)[]

The underlying ulong array that stores the bits.

count [int](#)

The total number of bits in the set.

Properties

Buffer

Gets the underlying ulong array that stores the bits.

```
public ulong[] Buffer { get; }
```

Property Value

[ulong](#)[]

Count

Gets the total number of bits in the set.

```
public int Count { get; }
```

Property Value

[int](#)

this[int]

Gets the bit value at the specified index.

```
public bool this[int index] { get; }
```

Parameters

[index](#) [int](#)

The zero-based index of the bit to get.

Property Value

[bool](#)

The bit value ([true](#) for 1, [false](#) for 0).

Exceptions

[ArgumentOutOfRangeException](#)

`index` is out of range.

Methods

At(int)

Gets the bit value at the specified index.

```
public bool At(int index)
```

Parameters

`index` [int](#)

The zero-based index of the bit to get.

Returns

[bool](#)

The bit value (`true` for 1, `false` for 0).

ToRankSelect(ImmutableBitSet, bool)

Creates a new [RankSelectBitSet](#) from the specified [ImmutableBitSet](#).

```
public static RankSelectBitSet ToRankSelect(ImmutableBitSet bitSet, bool createAuxDir  
= true)
```

Parameters

`bitSet` [ImmutableBitSet](#)

The source immutable bit set to convert.

`createAuxDir` [bool](#)

A value indicating whether to immediately create the auxiliary directories required for fast Rank and Select operations.

Returns

[RankSelectBitSet](#)

A new [RankSelectBitSet](#) instance.

Remarks

If `createAuxDir` is set to `false`, this method is very fast, but the returned [RankSelectBitSet](#) will not be ready for Rank/Select operations until its auxiliary directories are created and set via the [SetAuxDir\(\)](#) method. If set to `true` (the default), the auxiliary directories are created during this call, which takes more processing time but results in a fully initialized and ready-to-use object.

Exceptions

[ArgumentNullException](#)

`bitSet` is null.

ToRankSelect(bool)

Creates a new [RankSelectBitSet](#) from the specified [ImmutableBitSet](#).

```
public RankSelectBitSet ToRankSelect(bool createAuxDir = true)
```

Parameters

`createAuxDir` [bool](#)

A value indicating whether to immediately create the auxiliary directories required for fast Rank and Select operations.

Returns

[RankSelectBitSet](#)

A new [RankSelectBitSet](#) instance.

Remarks

If `createAuxDir` is set to `false`, this method is very fast, but the returned [RankSelectBitSet](#) will not be ready for Rank/Select operations until its auxiliary directories are created and set via the [SetAuxDir\(\)](#) method. If set to `true` (the default), the auxiliary directories are created during this call, which takes more processing time but results in a fully initialized and ready-to-use object.

Class KeyRecordDictionary

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

An abstract base class for advanced key-record dictionaries.

```
public abstract class KeyRecordDictionary
```

Inheritance

[object](#) ← KeyRecordDictionary

Derived

[DirectedAcyclicGraphDictionary](#), [DoubleArrayDictionary](#), [LevelOrderBitsDictionary](#)

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This class provides a framework for mapping byte array keys to linked lists of data records. It features a dual-storage system (transient and persistent) for records, supports different key search directions (LTR/RTL), and allows for custom metadata storage. Concrete implementations are expected to provide the specific key management structure (e.g., a trie).

Constructors

KeyRecordDictionary(SearchDirectionType)

An abstract base class for advanced key-record dictionaries.

```
protected KeyRecordDictionary(KeyRecordDictionary.SearchDirectionType searchDirection)
```

Parameters

searchDirection [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Remarks

This class provides a framework for mapping byte array keys to linked lists of data records. It features a dual-storage system (transient and persistent) for records, supports different key search directions (LTR/RTL), and allows for custom metadata storage. Concrete implementations are expected to provide the specific key management structure (e.g., a trie).

Properties

Additional1

Gets or sets a small, general-purpose byte array for additional persistent data.

```
public byte[] Additional1 { get; set; }
```

Property Value

[byte](#)[]

Remarks

The size of the byte array cannot exceed 4096 bytes.

Exceptions

[ArgumentNullException](#)

The assigned value is null.

[ArgumentOutOfRangeException](#)

The length of the assigned byte array is greater than 4096.

Additional2

Gets or sets a large, general-purpose byte array for additional persistent data.

```
public byte[] Additional2 { get; set; }
```

Property Value

[byte[↗] \[\]](#)

Remarks

The size of the byte array cannot exceed 1,073,741,824 bytes (1 GB).

Exceptions

[ArgumentNullException[↗]](#)

The assigned value is null.

[ArgumentOutOfRangeException[↗]](#)

The length of the assigned byte array is greater than 1 GB.

SearchDirection

Gets the search direction (Left-To-Right or Right-To-Left) for key operations.

```
public KeyRecordDictionary.SearchDirectionType SearchDirection { get; }
```

Property Value

[KeyRecordDictionary.SearchDirectionType](#)

Methods

Create<T>(SearchDirectionType)

Creates a new instance of a derived dictionary type with an empty set of keys.

```
public static T Create<T>(KeyRecordDictionary.SearchDirectionType searchDirection = SearchDirectionType.LTR) where T : KeyRecordDictionary
```

Parameters

`searchDirection` [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Returns

T

A new instance of the specified dictionary type.

Type Parameters

T

The concrete type of the dictionary to create.

Create<T>(IEnumerable<byte[]>, SearchDirectionType)

Creates a new instance of a derived dictionary type, populated with an initial set of keys.

```
public static T Create<T>(IEnumerable<byte[]> keys, KeyRecordDictionary.SearchDirectionType  
searchDirection = SearchDirectionType.LTR) where T : KeyRecordDictionary
```

Parameters

`keys` [IEnumerable<byte\[\]>](#)

An enumerable collection of byte arrays to use as the initial keys. The collection does not need to be pre-sorted. Duplicate keys are permitted, but only the first occurrence will be added. The collection must not contain any elements that are null or empty byte array.

`searchDirection` [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Returns

T

A new instance of the specified dictionary type.

Type Parameters

T

The concrete type of the dictionary to create.

Remarks

This method uses reflection to invoke the static `Create` method on the concrete derived type T.

Exceptions

[ArgumentNullException](#)

`keys` is null.

Create<T>(IEnumerable<string>, Encoding?, SearchDirectionType)

Creates a new instance of a derived dictionary type, populated with an initial set of string keys.

```
public static T Create<T>(IEnumerable<string> keys, Encoding? encoding = null,  
KeyRecordDictionary.SearchDirectionType searchDirection = SearchDirectionType.LTR) where T  
: KeyRecordDictionary
```

Parameters

`keys` [IEnumerable](#)<[string](#)>

An enumerable collection of strings to use as the initial keys. The collection does not need to be pre-sorted. Duplicate keys are permitted, but only the first occurrence will be added. The collection must not contain any elements that are null or empty strings.

`encoding` [Encoding](#)

The encoding to use for converting strings to bytes. Defaults to UTF-8.

`searchDirection` [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Returns

T

A new instance of the specified dictionary type.

Type Parameters

T

The concrete type of the dictionary to create.

Exceptions

[ArgumentNullException](#)

keys is null.

Deserialize<T>(byte[])

Deserializes a dictionary from a byte array.

```
public static T Deserialize<T>(byte[] data) where T : KeyRecordDictionary
```

Parameters

data [byte](#)[]

The byte array containing the serialized data.

Returns

T

A new instance of **T**.

Type Parameters

T

The concrete type of the dictionary to deserialize.

Remarks

This static method uses reflection to invoke the static `Deserialize` method on the specified type `T`.

Exceptions

[ArgumentNullException](#)

`data` is null.

Deserialize<T>(Stream)

Deserializes a dictionary from a stream.

```
public static T Deserialize<T>(Stream stream) where T : KeyRecordDictionary
```

Parameters

`stream` [Stream](#)

The stream to read the serialized data from.

Returns

`T`

A new instance of `T`.

Type Parameters

`T`

The concrete type of the dictionary to deserialize.

Exceptions

[ArgumentNullException](#)

`stream` is null.

[NotSupportedException](#)

The type `T` does not have a public static `Deserialize(Stream)` method.

Deserialize<T>(string)

Deserializes a dictionary from a file.

```
public static T Deserialize<T>(string file) where T : KeyRecordDictionary
```

Parameters

file [string](#)

The path of the file to read from.

Returns

T

A new instance of T.

Type Parameters

T

The concrete type of the dictionary to deserialize.

Remarks

This static method uses reflection to invoke the static [Deserialize](#) method on the specified type T.

Exceptions

[ArgumentNullException](#)

file is null.

[ArgumentException](#)

file is empty or whitespace.

Serialize<T>(T, SerializationOptions?)

Serializes the specified dictionary instance into a byte array.

```
public static byte[] Serialize<T>(T obj, KeyRecordDictionary.SerializationOptions? options = null) where T : KeyRecordDictionary
```

Parameters

obj **T**

The dictionary instance to serialize.

options [KeyRecordDictionary.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Returns

[byte](#) []

A byte array containing the serialized data.

Type Parameters

T

The concrete type of the dictionary.

Remarks

This static method uses reflection to invoke the static [Serialize](#) method on the concrete derived type **T**.

Exceptions

[ArgumentNullException](#)

obj is null.

Serialize<T>(T, Stream, SerializationOptions?)

Serializes the specified dictionary instance into a stream.

```
public static void Serialize<T>(T obj, Stream stream,
KeyRecordDictionary.SerializationOptions? options = null) where T : KeyRecordDictionary
```

Parameters

obj `T`

The dictionary instance to serialize.

stream [Stream](#)

The stream to write the serialized data to.

options [KeyRecordDictionary.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Type Parameters

`T`

The concrete type of the dictionary.

Exceptions

[ArgumentNullException](#)

`obj` or `stream` is null.

[NotSupportedException](#)

The type `T` does not have a public static `Serialize(T, Stream)` method.

`Serialize<T>(T, string, SerializationOptions?)`

Serializes the specified dictionary instance to a file.

```
public static void Serialize<T>(T obj, string file,  
KeyRecordDictionary.SerializationOptions? options = null) where T : KeyRecordDictionary
```

Parameters

obj `T`

The dictionary instance to serialize.

`file` `string`

The path of the file to create.

`options` [KeyRecordDictionary.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Type Parameters

`T`

The concrete type of the dictionary.

Remarks

This static method uses reflection to invoke the static `Serialize` method on the concrete derived type `T`.

Exceptions

[ArgumentNullException](#)

`obj` or `file` is null.

[ArgumentException](#)

`file` is empty or whitespace.

Interface KeyRecordDictionary.IKeyAccess

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Defines the primary public contract for all key-based operations within the dictionary.

```
public interface KeyRecordDictionary.IKeyAccess
```

Methods

Add(ReadOnlySpan<byte>)

Adds a key to the dictionary. If the key already exists, its existing identifier is returned.

```
int Add(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan<byte>](#)

The key to add.

Returns

[int](#)

The identifier for the added or existing key.

Exceptions

[ArgumentException](#)

key is empty.

AsStringSpecialized(Encoding?)

Returns a string-specialized wrapper for this key access interface.

```
KeyRecordDictionary.StringSpecialized AsStringSpecialized(Encoding? encoding = null)
```

Parameters

encoding [Encoding](#)

The encoding to use for string operations. Defaults to UTF-8.

Returns

[KeyRecordDictionary.StringSpecialized](#)

A new [KeyRecordDictionary.StringSpecialized](#) instance.

Contains(ReadOnlySpan<byte>)

Determines whether the dictionary contains the specified key.

```
bool Contains(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan](#)<[byte](#)>

The key to locate.

Returns

[bool](#)

true if the key is found; otherwise, false.

EnumerateAll(bool)

Enumerates all keys in the dictionary.

```
IEnumerable<(int, byte[])> EnumerateAll(bool reverse = false)
```

Parameters

reverse [bool](#)

If true, returns keys in reverse lexicographical order.

Returns

[IEnumerable](#)<(int, byte[])>

An enumerable collection of all (identifier, key) tuples.

FindFirst(out int, out byte[])

Finds the first key in the dictionary according to the current sort order.

bool [FindFirst](#)(out int identifier, out byte[] key)

Parameters

identifier [int](#)

When this method returns, the identifier of the first key.

key [byte](#)[]

When this method returns, the first key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindLast(out int, out byte[])

Finds the last key in the dictionary according to the current sort order.

bool [FindLast](#)(out int identifier, out byte[] key)

Parameters

identifier [int](#)

When this method returns, the identifier of the last key.

key [byte](#)[]

When this method returns, the last key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindNext(int, out int, out byte[])

Finds the next key in sequence after the specified identifier.

```
bool FindNext(int currentIdentifier, out int foundIdentifier, out byte[] foundKey)
```

Parameters

currentIdentifier [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [byte](#)[]

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindNext(ReadOnlySpan<byte>, out int, out byte[])

Finds the next key in sequence after the specified key.

```
bool FindNext(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan<byte>](#)

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [byte\[\]](#)

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindPrevious(int, out int, out byte[])

Finds the previous key in sequence before the specified identifier.

```
bool FindPrevious(int currentIdentifier, out int foundIdentifier, out byte[] foundKey)
```

Parameters

currentIdentifier [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [byte\[\]](#)

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

FindPrevious(ReadOnlySpan<byte>, out int, out byte[])

Finds the previous key in sequence before the specified key.

```
bool FindPrevious(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out  
byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan<byte>](#)

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [byte\[\]](#)

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

GetKey(int)

Gets the key associated with the specified identifier.

```
byte[] GetKey(int identifier)
```

Parameters

identifier [int](#)

The identifier of the key to get.

Returns

[byte](#)[]

The key as a byte array.

Exceptions

[KeyNotFoundException](#)

The specified identifier does not exist.

GetRecordAccess(int, bool)

Gets an accessor for the list of records associated with a given key identifier.

```
KeyRecordDictionary.IRecordAccess GetRecordAccess(int identifier, bool isTransient = false)
```

Parameters

identifier [int](#)

The identifier of the key whose records are to be accessed.

isTransient [bool](#)

If true, accesses the transient record store; otherwise, accesses the persistent record store.

Returns

[KeyRecordDictionary.IRecordAccess](#)

An [KeyRecordDictionary.IRecordAccess](#) handle for the specified record list.

Remove(int)

Removes a key from the dictionary using its identifier.

```
bool Remove(int identifier)
```

Parameters

identifier [int](#)

The identifier of the key to remove.

Returns

[bool](#)

true if the key was found and removed; otherwise, false.

Remove(ReadOnlySpan<byte>)

Removes a key from the dictionary.

```
bool Remove(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan](#)<[byte](#)>

The key to remove.

Returns

[bool](#)

true if the key was found and removed; otherwise, false.

SearchByPrefix(ReadOnlySpan<byte>, bool)

Finds all keys that start with the given prefix.

```
IEnumerable<(int, byte[])> SearchByPrefix(ReadOnlySpan<byte> sequence, bool reverse = false)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The prefix to search for.

reverse [bool](#)

If true, returns results in reverse lexicographical order.

Returns

[IEnumerable<\(int, byte\[\]\)>](#)

An enumerable collection of (identifier, key) tuples for all keys starting with the prefix.

Examples

If the dictionary contains the keys "a", "app", and "apple", and the input sequence is "ap", this method will return two keys: "app" and "apple".

SearchCommonPrefix(ReadOnlySpan<byte>)

Finds all keys in the dictionary that are prefixes of the given sequence.

```
IEnumerable<(int, byte[])> SearchCommonPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The sequence to search within.

Returns

[IEnumerable<\(int, byte\[\]\)>](#)

An enumerable collection of (identifier, key) tuples for all matching prefixes.

Examples

If the dictionary contains the keys "a", "app", and "apple", and the input sequence is "applepie", this method will return all three keys: "a", "app", and "apple".

SearchExactly(ReadOnlySpan<byte>)

Searches for an exact match of the given sequence and returns its identifier.

```
int SearchExactly(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The key to search for.

Returns

[int](#)

The identifier for the key if found; otherwise, a value indicating not found (typically 0 or -1).

Examples

If the dictionary contains the keys "a", "app", and "apple", and the input sequence is "apple", this method will return a key: "apple".

SearchLongestPrefix(ReadOnlySpan<byte>)

Finds the longest key in the dictionary that is a prefix of the given sequence.

```
(int, byte[]) SearchLongestPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The sequence to search within.

Returns

`(int[], byte[][])`

A tuple containing the identifier and key of the longest matching prefix, or a default value if no match is found.

Examples

If the dictionary contains the keys "a", "app", and "apple", and the input sequence is "applepie", this method will return a key: "apple".

SearchWildcard(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool)

Performs a wildcard search for keys matching a pattern.

```
IEnumerable<(int, byte[])> SearchWildcard(ReadOnlySpan<byte> sequence, ReadOnlySpan<char> cards, bool reverse = false)
```

Parameters

`sequence` `ReadOnlySpan<byte[]>`

The byte sequence of the pattern.

`cards` `ReadOnlySpan<char[]>`

A sequence of characters ('?' for single, '*' for multiple wildcards) corresponding to the pattern.

`reverse` `bool`

If true, returns results in reverse order.

Returns

`IEnumerable<(int[], byte[][])>`

An enumerable collection of matching (identifier, key) tuples.

Examples

If the dictionary contains the keys "a", "app", and "apple", and the input sequence is "a?p*", this method will return two keys: "app" and "apple". The search pattern is provided as two separate arguments (`sequence` and `cards`) to unambiguously support searching for any possible byte value (0-255). The `sequence` span contains the literal byte values for the pattern, while the `cards` span defines the role of each corresponding position. This design allows a search to include literal byte values that might otherwise be interpreted as wildcard characters (e.g., the byte value 63, which is the ASCII code for '?').

TryAdd(ReadOnlySpan<byte>, out int)

Tries to add a key to the dictionary.

```
bool TryAdd(ReadOnlySpan<byte> key, out int identifier)
```

Parameters

`key` [ReadOnlySpan<byte>](#)

The key to add.

`identifier` [int](#)

When this method returns, contains the identifier for the new key. If the key already existed, this will be the existing identifier.

Returns

[bool](#)

true if the key was newly added; false if the key already existed.

Exceptions

[ArgumentException](#)

`key` is empty.

TryGetKey(int, out byte[])

Tries to get the key associated with the specified identifier.

```
bool TryGetKey(int identifier, out byte[] key)
```

Parameters

identifier [int](#)

The identifier of the key to get.

key [byte](#)[]

When this method returns, contains the key associated with the identifier, if found; otherwise, an empty array.

Returns

[bool](#)

true if the key was found; otherwise, false.

Interface KeyRecordDictionary.IRecord

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Defines a public contract for a single data record.

```
public interface KeyRecordDictionary.IRecord
```

Properties

Content

Gets or sets the byte array content of this record.

```
byte[] Content { get; set; }
```

Property Value

[byte](#) []

ExByte

Gets or sets an extra, user-definable byte of metadata associated with this record (0-255). Not supported by all underlying record stores, only supported by [PrimitiveRecordStore](#).

```
int ExByte { get; set; }
```

Property Value

[int](#) []

Next

Gets the next record in the linked list, or null if this is the last record.

```
KeyRecordDictionary.IRecord? Next { get; }
```

Property Value

[KeyRecordDictionary.IRecord](#)

Methods

InsertAfter(ReadOnlySpan<byte>)

Inserts a new record immediately after this record in the list.

```
KeyRecordDictionary.IRecord InsertAfter(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record to insert.

Returns

[KeyRecordDictionary.IRecord](#)

An [KeyRecordDictionary.IRecord](#) handle for the newly inserted record.

InsertBefore(ReadOnlySpan<byte>)

Inserts a new record immediately before this record in the list.

```
KeyRecordDictionary.IRecord InsertBefore(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record to insert.

Returns

[KeyRecordDictionary.IRecord](#)

An [KeyRecordDictionary.IRecord](#) handle for the newly inserted record.

Remove()

Removes this record from the list it belongs to.

```
void Remove()
```

Interface KeyRecordDictionary.IRecordAccess

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Defines a public contract for accessing and managing a list of records associated with a single key.

```
public interface KeyRecordDictionary.IRecordAccess :  
IEnumerable<KeyRecordDictionary.IRecord>, IEnumerable
```

Inherited Members

[IEnumerable<KeyRecordDictionary.IRecord>.GetEnumerator\(\)](#)

Methods

Add(ReadOnlySpan<byte>)

Adds a new record with the specified content to the end of the list.

KeyRecordDictionary.IRecord **Add**(ReadOnlySpan<byte> content)

Parameters

content [ReadOnlySpan](#)<byte>

The content of the new record.

Returns

[KeyRecordDictionary.IRecord](#)

An [KeyRecordDictionary.IRecord](#) handle for the newly added record.

Clear()

Removes all records from this list.

```
void Clear()
```

Enum KeyRecordDictionary.SearchDirectionType

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Specifies the direction for key matching and sorting operations.

```
public enum KeyRecordDictionary.SearchDirectionType
```

Fields

LTR = 0

Left-To-Right search, representing standard lexicographical order.

RTL = 1

Right-To-Left search, useful for suffix matching and reverse lexicographical order.

Class KeyRecordDictionary.SerializationOptions

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides options to control the serialization process for dictionary data structures.

```
public class KeyRecordDictionary.SerializationOptions
```

Inheritance

[object](#) ← KeyRecordDictionary.SerializationOptions

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Properties

CompressionLevel

Gets or sets the compression level to use for serialization.

```
public CompressionLevel CompressionLevel { get; set; }
```

Property Value

[CompressionLevel](#)

Remarks

Higher compression levels can result in smaller file sizes but may take longer to process. Defaults to [Fastest](#) for a balance of speed and size.

Default

Gets a singleton instance of [KeyRecordDictionary.SerializationOptions](#) with default values.

```
public static KeyRecordDictionary.SerializationOptions Default { get; }
```

Property Value

[KeyRecordDictionary.SerializationOptions](#)

Remarks

Use this property to avoid creating a new options object when default settings are sufficient.

IncludeLoudsParentPointers

[LOUDS-specific] Gets or sets a value indicating whether to include the parent pointer array in the serialization output. Defaults to [false](#).

```
public bool IncludeLoudsParentPointers { get; set; }
```

Property Value

[bool](#)

Remarks

Setting this to [false](#) will reduce the final file size, but it may significantly increase the time required for deserialization as the parent structure needs to be rebuilt.

Class KeyRecordDictionary.StringSpecialized

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides a string-specialized wrapper around an [KeyRecordDictionary.IKeyAccess](#) instance, simplifying operations by handling string-to-byte encoding and decoding.

```
public sealed class KeyRecordDictionary.StringSpecialized
```

Inheritance

[object](#) ← KeyRecordDictionary.StringSpecialized

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Properties

Dictionary

Gets the underlying [KeyRecordDictionary.IKeyAccess](#) dictionary.

```
public KeyRecordDictionary.IKeyAccess Dictionary { get; }
```

Property Value

[KeyRecordDictionary.IKeyAccess](#)

Encoding

Gets the [Encoding](#) used for string conversions.

```
public Encoding Encoding { get; }
```

Property Value

Methods

Add(string)

Adds a key to the dictionary. If the key already exists, its existing identifier is returned.

```
public int Add(string key)
```

Parameters

key [string ↗](#)

The string key to add.

Returns

[int ↗](#)

The identifier for the added or existing key.

Exceptions

[ArgumentNullException ↗](#)

key is null.

[ArgumentException ↗](#)

key is empty.

Contains(string)

Determines whether the dictionary contains the specified key.

```
public bool Contains(string key)
```

Parameters

key [string](#)

The string key to locate.

Returns

[bool](#)

true if the key is found; otherwise, false.

Exceptions

[ArgumentNullException](#)

key is null.

EnumerateAll(bool)

Enumerates all keys in the dictionary as strings.

```
public IEnumerable<(int, string)> EnumerateAll(bool reverse = false)
```

Parameters

reverse [bool](#)

If true, returns keys in reverse order.

Returns

[IEnumerable](#) <(int, string)>

An enumerable collection of all (identifier, key) string tuples.

FindFirst(out int, out string)

Finds the first key in the dictionary according to the current sort order.

```
public bool FindFirst(out int identifier, out string key)
```

Parameters

identifier [int ↗](#)

When this method returns, the identifier of the first key.

key [string ↗](#)

When this method returns, the first key as a string.

Returns

[bool ↗](#)

true if the dictionary is not empty; otherwise, false.

FindLast(out int, out string)

Finds the last key in the dictionary according to the current sort order.

```
public bool FindLast(out int identifier, out string key)
```

Parameters

identifier [int ↗](#)

When this method returns, the identifier of the last key.

key [string ↗](#)

When this method returns, the last key as a string.

Returns

[bool ↗](#)

true if the dictionary is not empty; otherwise, false.

FindNext(int, out int, out string)

Finds the next key in sequence after the specified identifier.

```
public bool FindNext(int currentIdentifier, out int foundIdentifier, out string foundKey)
```

Parameters

currentIdentifier [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [string](#)

When this method returns, the next key as a string.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindNext(string, out int, out string)

Finds the next key in sequence after the specified key.

```
public bool FindNext(string currentKey, out int foundIdentifier, out string foundKey)
```

Parameters

currentKey [string](#)

The string key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [string](#)

When this method returns, the next key as a string.

Returns

[bool](#)

true if a next key was found; otherwise, false.

Exceptions

[ArgumentNullException](#)

`currentKey` is null.

FindPrevious(int, out int, out string)

Finds the previous key in sequence before the specified identifier.

```
public bool FindPrevious(int currentIdentifier, out int foundIdentifier, out
string foundKey)
```

Parameters

`currentIdentifier` [int](#)

The identifier to start the search from.

`foundIdentifier` [int](#)

When this method returns, the identifier of the previous key.

`foundKey` [string](#)

When this method returns, the previous key as a string.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

FindPrevious(string, out int, out string)

Finds the previous key in sequence before the specified key.

```
public bool FindPrevious(string currentKey, out int foundIdentifier, out string foundKey)
```

Parameters

currentKey [string](#)

The string key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [string](#)

When this method returns, the previous key as a string.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

Exceptions

[ArgumentNullException](#)

currentKey is null.

GetKey(int)

Gets the key associated with the specified identifier.

```
public string GetKey(int identifier)
```

Parameters

identifier [int](#)

The identifier of the key to get.

Returns

[string](#)

The key as a string.

GetRecordAccess(int, bool)

Gets an accessor for the list of records associated with a given key identifier.

```
public KeyRecordDictionary.IRecordAccess GetRecordAccess(int identifier, bool isTransient = false)
```

Parameters

identifier [int](#)

The identifier of the key whose records are to be accessed.

isTransient [bool](#)

If true, accesses the transient record store; otherwise, accesses the persistent record store.

Returns

[KeyRecordDictionary.IRecordAccess](#)

An [KeyRecordDictionary.IRecordAccess](#) handle for the specified record list.

Remove(string)

Removes a key from the dictionary.

```
public bool Remove(string key)
```

Parameters

key [string](#)

The string key to remove.

Returns

[bool](#)

true if the key was found and removed; otherwise, false.

Exceptions

[ArgumentNullException](#)

key is null.

SearchByPrefix(string, bool)

Finds all keys that start with the given prefix.

```
public IEnumerable<(int, string)> SearchByPrefix(string text, bool reverse = false)
```

Parameters

text [string](#)

The prefix to search for.

reverse [bool](#)

If true, returns results in reverse order.

Returns

[IEnumerable](#)<(int, string)>

An enumerable collection of (identifier, key) string tuples.

Remarks

This is the string-specialized version of this method. For detailed behavior and examples, see [SearchByPrefix\(ReadOnlySpan<byte>, bool\)](#).

Exceptions

[ArgumentNullException](#)

`text` is null.

SearchCommonPrefix(string)

Finds all keys in the dictionary that are prefixes of the given text.

```
public IEnumerable<(int, string)> SearchCommonPrefix(string text)
```

Parameters

`text` [string](#)

The text to search within.

Returns

[IEnumerable](#)<(int, string)>

An enumerable collection of (identifier, key) string tuples for all matching prefixes.

Remarks

This is the string-specialized version of this method. For detailed behavior and examples, see [SearchCommonPrefix\(ReadOnlySpan<byte>\)](#).

Exceptions

[ArgumentNullException](#)

`text` is null.

SearchExactly(string)

Searches for an exact match of the given text and returns its identifier.

```
public int SearchExactly(string text)
```

Parameters

text [string](#)

The string key to search for.

Returns

[int](#)

The identifier for the key if found; otherwise, a value indicating not found.

Exceptions

[ArgumentNullException](#)

text is null.

SearchLongestPrefix(string)

Finds the longest key in the dictionary that is a prefix of the given text.

```
public (int, string) SearchLongestPrefix(string text)
```

Parameters

text [string](#)

The text to search within.

Returns

[\(int, string\)](#)

A tuple containing the identifier and string key of the longest matching prefix, or (-1, "") if no match is found.

Remarks

This is the string-specialized version of this method. For detailed behavior and examples, see [SearchLongestPrefix\(ReadOnlySpan<byte>\)](#).

Exceptions

[ArgumentNullException](#)

`text` is null.

SearchWildcard(string, char, char, bool)

Performs a wildcard search using user-defined wildcard characters.

```
public IEnumerable<(int, string)> SearchWildcard(string pattern, char cardQ = '?', char cardA = '*', bool reverse = false)
```

Parameters

`pattern` [string](#)

The search pattern.

`cardQ` [char](#)

The character to be treated as a single-character wildcard ('?'), which matches any single character.

`cardA` [char](#)

The character to be treated as a multi-character wildcard ('*'), which matches any sequence of zero or more characters.

`reverse` [bool](#)

If true, returns results in reverse order.

Returns

[IEnumerable](#) <(int, string)>

An enumerable collection of matching (identifier, key) string tuples.

Remarks

This is a convenience method that provides a simple way to perform wildcard searches. It internally translates the pattern for use by the more advanced [SearchWildcard\(string, string, bool\)](#) overload. A call like

```
SearchWildcard("Hell?*World")
```

is internally converted to an equivalent call:

```
SearchWildcard("Hell?*World", "....?*....")
```

The second argument, "cards", specifies that '?' and '*' should be treated as wildcards, while '.' indicates a literal character match.

Encoding Limitation: The multi-character wildcard ('*') is only fully supported for single-byte encodings (codepage 1252, 20127 and 28591). The single-character wildcard ('?') is supported for some encodings (codepage 1200, 1201, 1252, 12000, 20127 and 28591).

Exceptions

[ArgumentNullException](#)

`pattern` is null.

[NotSupportedException](#)

The current encoding is not supported for wildcard searches.

SearchWildcard(string, string, bool)

Performs a wildcard search using a standardized wildcard pattern.

```
public IEnumerable<(int, string)> SearchWildcard(string text, string cards, bool reverse  
= false)
```

Parameters

`text` [string](#)

The search pattern as a string.

`cards` [string](#)

A string of the same length as `text`'s byte representation, where '?' is a single wildcard, '*' is a multiple wildcard, and '.' is a literal match.

`reverse` `bool` ↗

If true, returns results in reverse order.

Returns

`IEnumerable` ↗ <(`int` ↗, `string` ↗)>

An enumerable collection of matching (identifier, key) string tuples.

Remarks

This is the string-specialized version of this method. For detailed behavior and examples, see [SearchWildcard\(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool\)](#).

Encoding Limitation: The multi-character wildcard ('*') is only fully supported for single-byte encodings (codepage 1252, 20127 and 28591). The single-character wildcard ('?') is supported for some encodings (codepage 1200, 1201, 1252, 12000, 20127 and 28591).

Exceptions

[ArgumentNullException](#) ↗

`text` is null.

[ArgumentNullException](#) ↗

`cards` is null.

[ArgumentException](#) ↗

`cards` and `cards` are different length.

[NotSupportedException](#) ↗

The current encoding is not supported for wildcard searches.

TryAdd(string, out int)

Tries to add a key to the dictionary.

```
public bool TryAdd(string key, out int identifier)
```

Parameters

key [string](#)

The string key to add.

identifier [int](#)

When this method returns, contains the identifier for the new key. If the key already existed, this will be the existing identifier.

Returns

[bool](#)

true if the key was newly added; false if the key already existed.

Exceptions

[ArgumentNullException](#)

key is null.

[ArgumentException](#)

key is empty.

TryGetKey(int, out string)

Tries to get the key associated with the specified identifier.

```
public bool TryGetKey(int identifier, out string key)
```

Parameters

identifier [int](#)

The identifier of the key to get.

key [string](#)

When this method returns, contains the key as a string, if found; otherwise, an empty string.

Returns

[bool](#)

true if the key was found; otherwise, false.

Class LevelOrderBitsDictionary

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

An abstract base class for read-only, trie-based dictionaries that are constructed in level-order.

```
public abstract class LevelOrderBitsDictionary : KeyRecordDictionary,  
KeyRecordDictionary.IKeyAccess
```

Inheritance

[object](#) ← [KeyRecordDictionary](#) ← LevelOrderBitsDictionary

Implements

[KeyRecordDictionary.IKeyAccess](#)

Derived

[BitwiseVectorDictionary](#), [LoudsDictionary](#)

Inherited Members

[KeyRecordDictionary.SearchDirection](#), [KeyRecordDictionary.Additional1](#),
[KeyRecordDictionary.Additional2](#),
[KeyRecordDictionary.Create<T>\(KeyRecordDictionary.SearchDirectionType\)](#),
[KeyRecordDictionary.Create<T>\(IEnumerable<byte\[\]>, KeyRecordDictionary.SearchDirectionType\)](#),
[KeyRecordDictionary.Create<T>\(IEnumerable<string>, Encoding,](#)
[KeyRecordDictionary.SearchDirectionType\)](#),
[KeyRecordDictionary.Serialize<T>\(T, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Serialize<T>\(T, string, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Serialize<T>\(T, Stream, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Deserialize<T>\(byte\[\]\)](#), [KeyRecordDictionary.Deserialize<T>\(string\)](#),
[KeyRecordDictionary.Deserialize<T>\(Stream\)](#), [object.Equals\(object\)](#), [object.Equals\(object, object\)](#),
[object.GetHashCode\(\)](#), [object.GetType\(\)](#), [object.MemberwiseClone\(\)](#),
[object.ReferenceEquals\(object, object\)](#), [object.ToString\(\)](#)

Remarks

This class provides the common infrastructure for trie implementations that are "flattened" into arrays based on a breadth-first (level-order) traversal. The core data is stored in arrays for labels, parent pointers, and terminal node flags.

Concrete implementations must provide a strategy for navigating the tree structure, primarily by implementing the `FindRange1(int)` method.

Important Usage Notes: This class and its derivatives are read-only after creation. Key addition and removal operations are not supported.

Methods

Add(ReadOnlySpan<byte>)

This operation is not supported. The dictionary is read-only after creation.

```
public int Add(ReadOnlySpan<byte> key)
```

Parameters

`key` [ReadOnlySpan<byte>](#)

Returns

[int](#)

Exceptions

[NotSupportedException](#)

Always thrown.

AsStringSpecialized(Encoding?)

Returns a string-specialized wrapper for the dictionary's key access interface.

```
public KeyRecordDictionary.StringSpecialized AsStringSpecialized(Encoding? encoding = null)
```

Parameters

`encoding` [Encoding](#)

The encoding to use for string conversions. Defaults to UTF-8.

Returns

[KeyRecordDictionary.StringSpecialized](#)

A new [KeyRecordDictionary.StringSpecialized](#) instance providing string-based access to the dictionary.

Contains(ReadOnlySpan<byte>)

Determines whether the specified key exists in the graph.

```
public virtual bool Contains(ReadOnlySpan<byte> key)
```

Parameters

key [ReadOnlySpan<byte>](#)

The key to locate.

Returns

[bool](#)

true if the key is found; otherwise, false.

EnumerateAll(bool)

Enumerates all keys in the dictionary in lexicographical order.

```
public virtual IEnumerable<(int, byte[])> EnumerateAll(bool reverse = false)
```

Parameters

reverse [bool](#)

If true, returns keys in reverse lexicographical order.

Returns

[IEnumerable<\(int, byte\[\]\)>](#)

An enumerable collection of all (identifier, key) tuples.

FindFirst(out int, out byte[])

Finds the first key in the dictionary in lexicographical order.

```
public virtual bool FindFirst(out int identifier, out byte[] key)
```

Parameters

identifier [int](#)

When this method returns, the identifier of the first key.

key [byte](#)[]

When this method returns, the first key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindLast(out int, out byte[])

Finds the last key in the dictionary in lexicographical order.

```
public virtual bool FindLast(out int identifier, out byte[] key)
```

Parameters

identifier [int](#)

When this method returns, the identifier of the last key.

key [byte](#)[]

When this method returns, the last key.

Returns

[bool](#)

true if the dictionary is not empty; otherwise, false.

FindNext(int, out int, out byte[])

Finds the next key in lexicographical order after the specified identifier.

```
public virtual bool FindNext(int currentIdentifier, out int foundIdentifier, out  
byte[] foundKey)
```

Parameters

[currentIdentifier](#) [int](#)

The identifier to start the search from.

[foundIdentifier](#) [int](#)

When this method returns, the identifier of the next key.

[foundKey](#) [byte](#)[]

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindNext(ReadOnlySpan<byte>, out int, out byte[])

Finds the next key in lexicographical order after the specified key.

```
public virtual bool FindNext(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out  
byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan<byte>](#)

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the next key.

foundKey [byte\[\]](#)

When this method returns, the next key.

Returns

[bool](#)

true if a next key was found; otherwise, false.

FindPrevious(int, out int, out byte[])

Finds the previous key in lexicographical order before the specified identifier.

```
public virtual bool FindPrevious(int currentIdentifier, out int foundIdentifier, out  
byte[] foundKey)
```

Parameters

currentIdentifier [int](#)

The identifier to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [byte\[\]](#)

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

FindPrevious(ReadOnlySpan<byte>, out int, out byte[])

Finds the previous key in lexicographical order before the specified key.

```
public virtual bool FindPrevious(ReadOnlySpan<byte> currentKey, out int foundIdentifier, out byte[] foundKey)
```

Parameters

currentKey [ReadOnlySpan](#)<[byte](#)>

The key to start the search from.

foundIdentifier [int](#)

When this method returns, the identifier of the previous key.

foundKey [byte](#)[]

When this method returns, the previous key.

Returns

[bool](#)

true if a previous key was found; otherwise, false.

GetKey(int)

Gets the key associated with the specified identifier.

```
public virtual byte[] GetKey(int identifier)
```

Parameters

identifier [int](#)

The identifier of the key to get.

Returns

[byte\[\]](#)

The key as a byte array.

Exceptions

[ArgumentOutOfRangeException](#)

The specified identifier does not exist.

GetRecordAccess(int, bool)

Gets an accessor for the list of records associated with a given key identifier.

```
public KeyRecordDictionary.IRecordAccess GetRecordAccess(int identifier, bool isTransient  
= false)
```

Parameters

identifier [int](#)

The identifier of the key whose records are to be accessed. This must be a valid key identifier obtained from a search or add operation.

isTransient [bool](#)

If true, accesses the transient (in-memory) record store; otherwise, accesses the persistent record store.

Returns

[KeyRecordDictionary.IRecordAccess](#)

An [KeyRecordDictionary.IRecordAccess](#) handle for the specified record list.

Remarks

Note that while new records can be added to a key's record list, new keys cannot be added to the dictionary itself after creation.

Exceptions

[ArgumentOutOfRangeException](#)

`identifier` is negative.

[ArgumentException](#)

The specified `identifier` is invalid or does not exist.

Remove(int)

This operation is not supported. The dictionary is read-only after creation.

```
public bool Remove(int identifier)
```

Parameters

`identifier` [int](#)

Returns

[bool](#)

Exceptions

[NotSupportedException](#)

Always thrown.

Remove(ReadOnlySpan<byte>)

This operation is not supported. The dictionary is read-only after creation.

```
public bool Remove(ReadOnlySpan<byte> key)
```

Parameters

`key` [ReadOnlySpan](#)<[byte](#)>

Returns

[bool](#)

Exceptions

[NotSupportedException](#)

Always thrown.

SearchByPrefix(ReadOnlySpan<byte>, bool)

Finds all keys that start with the given prefix.

```
public virtual IEnumerable<(int, byte[])> SearchByPrefix(ReadOnlySpan<byte> sequence, bool  
reverse = false)
```

Parameters

sequence [ReadOnlySpan](#)<[byte](#)>

The prefix to search for.

reverse [bool](#)

If true, returns results in reverse lexicographical order.

Returns

[IEnumerable](#)<(int, byte[])>

An enumerable collection of (identifier, key) tuples for all keys starting with the prefix.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchByPrefix\(ReadOnlySpan<byte>, bool\)](#).

SearchCommonPrefix(ReadOnlySpan<byte>)

Finds all keys in the dictionary that are prefixes of the given sequence.

```
public virtual IEnumerable<(int, byte[])> SearchCommonPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The sequence to search within.

Returns

[IEnumerable<\(int, byte\[\]\)>](#)

An enumerable collection of (identifier, key) tuples for all matching prefixes.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchCommonPrefix\(ReadOnlySpan<byte>\)](#).

SearchExactly(ReadOnlySpan<byte>)

Searches for an exact match of the given sequence and returns its identifier.

```
public virtual int SearchExactly(ReadOnlySpan<byte> sequence)
```

Parameters

sequence [ReadOnlySpan<byte>](#)

The key to search for.

Returns

[int](#)

The positive identifier for the key if found; otherwise, a non-positive value.

SearchLongestPrefix(ReadOnlySpan<byte>)

Finds the longest key in the dictionary that is a prefix of the given sequence.

```
public virtual (int, byte[]) SearchLongestPrefix(ReadOnlySpan<byte> sequence)
```

Parameters

`sequence` [ReadOnlySpan<byte>](#)

The sequence to search within.

Returns

[\(int, byte\[\]\)](#)

A tuple containing the identifier and key of the longest matching prefix, or (-1, []) if no match is found.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchLongestPrefix\(ReadOnlySpan<byte>\)](#).

SearchWildcard(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool)

Performs a wildcard search for keys matching a pattern.

```
public virtual IEnumerable<(int, byte[])> SearchWildcard(ReadOnlySpan<byte> sequence,  
    ReadOnlySpan<char> cards, bool reverse = false)
```

Parameters

`sequence` [ReadOnlySpan<byte>](#)

The byte sequence of the pattern.

`cards` [ReadOnlySpan<char>](#)

A sequence of characters ('?' for single, '*' for multiple wildcards) corresponding to the pattern.

`reverse` [bool](#)

If true, returns results in reverse order.

Returns

[IEnumerable<\(int, byte\[\]\)>](#)

An enumerable collection of matching (identifier, key) tuples.

Remarks

This is the implementation of interface method. For detailed behavior and examples, see [SearchWildcard\(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool\)](#).

TryAdd(ReadOnlySpan<byte>, out int)

This operation is not supported. The dictionary is read-only after creation.

```
public bool TryAdd(ReadOnlySpan<byte> key, out int identifier)
```

Parameters

key [ReadOnlySpan<byte>](#)

identifier [int](#)

Returns

[bool](#)

Exceptions

[NotSupportedException](#)

Always thrown.

TryGetKey(int, out byte[])

Tries to get the key associated with the specified identifier.

```
public virtual bool TryGetKey(int identifier, out byte[] key)
```

Parameters

identifier [int](#)

The identifier of the key to get.

key [byte](#)[]

When this method returns, contains the key if found; otherwise, an empty array.

Returns

[bool](#)

true if the key was found; otherwise, false.

Class LoudsDictionary

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [KeyRecordDictionary](#) that uses a memory-efficient LOUDS (Level-Order Unary Degree Sequence) trie.

```
public abstract class LoudsDictionary : LevelOrderBitsDictionary,  
KeyRecordDictionary.IKeyAccess
```

Inheritance

[object](#) ← [KeyRecordDictionary](#) ← [LevelOrderBitsDictionary](#) ← LoudsDictionary

Implements

[KeyRecordDictionary.IKeyAccess](#)

Inherited Members

[LevelOrderBitsDictionary.AsStringSpecialized\(Encoding\)](#) ,
[LevelOrderBitsDictionary.GetRecordAccess\(int, bool\)](#) ,
[LevelOrderBitsDictionary.Contains\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchExactly\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchCommonPrefix\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchLongestPrefix\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.SearchByPrefix\(ReadOnlySpan<byte>, bool\)](#) ,
[LevelOrderBitsDictionary.EnumerateAll\(bool\)](#) ,
[LevelOrderBitsDictionary.SearchWildcard\(ReadOnlySpan<byte>, ReadOnlySpan<char>, bool\)](#) ,
[LevelOrderBitsDictionary.FindFirst\(out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindLast\(out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindNext\(int, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindNext\(ReadOnlySpan<byte>, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindPrevious\(int, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.FindPrevious\(ReadOnlySpan<byte>, out int, out byte\[\]\)](#) ,
[LevelOrderBitsDictionary.TryGetKey\(int, out byte\[\]\)](#) , [LevelOrderBitsDictionary.GetKey\(int\)](#) ,
[LevelOrderBitsDictionary.Add\(ReadOnlySpan<byte>\)](#) ,
[LevelOrderBitsDictionary.TryAdd\(ReadOnlySpan<byte>, out int\)](#) , [LevelOrderBitsDictionary.Remove\(int\)](#) ,
[LevelOrderBitsDictionary.Remove\(ReadOnlySpan<byte>\)](#) , [KeyRecordDictionary.SearchDirection](#) ,
[KeyRecordDictionary.Additional1](#) , [KeyRecordDictionary.Additional2](#) ,
[KeyRecordDictionary.Create<T>\(KeyRecordDictionary.SearchDirectionType\)](#) ,
[KeyRecordDictionary.Create<T>\(IEnumerable<byte\[\]>, KeyRecordDictionary.SearchDirectionType\)](#) ,

[KeyRecordDictionary.Create<T>\(IEnumerable<string>, Encoding, KeyRecordDictionary.SearchDirectionType\)](#),
[KeyRecordDictionary.Serialize<T>\(T, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Serialize<T>\(T, string, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Serialize<T>\(T, Stream, KeyRecordDictionary.SerializationOptions\)](#),
[KeyRecordDictionary.Deserialize<T>\(byte\[\]\)](#), [KeyRecordDictionary.Deserialize<T>\(string\)](#),
[KeyRecordDictionary.Deserialize<T>\(Stream\)](#), [object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) ,
[object.GetHashCode\(\)](#) , [object.GetType\(\)](#) , [object.MemberwiseClone\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This class represents a trie data structure using a compact, bit-level representation to achieve significant memory savings. The structure is built from a sorted set of keys and is highly optimized for prefix-based searches.

Important Usage Notes:

- **Read-Only Structure:** Like the DAWG implementation, this dictionary is built once and is effectively read-only. Key addition and removal operations are not supported and will throw a [NotSupportedException](#).
- **Key Reconstruction:** Getting a key by its identifier requires traversing the structure from a node up to the root.

Methods

Create(IEnumerable<byte[]>, SearchDirectionType)

Creates a new [LoudsDictionary](#) from a collection of keys.

```
public static LoudsDictionary Create(IEnumerable<byte[]> keys,  
KeyRecordDictionary.SearchDirectionType searchDirection = SearchDirectionType.LTR)
```

Parameters

keys [IEnumerable<byte\[\]>](#)

An enumerable collection of byte arrays to use as the initial keys. The collection does not need to be pre-sorted. Duplicate keys are permitted, but only the first occurrence will be added. The collection must not contain any elements that are null or empty byte array.

`searchDirection` [KeyRecordDictionary.SearchDirectionType](#)

The key search direction for the new dictionary.

Returns

[LoudsDictionary](#)

A new, optimized, and read-only [LoudsDictionary](#) instance.

Remarks

The input keys are sorted and used to construct the LOUDS trie representation.

Exceptions

[ArgumentNullException](#)

`keys` is null.

Deserialize(Stream)

Deserializes a dictionary from a stream.

```
public static LoudsDictionary Deserialize(Stream stream)
```

Parameters

`stream` [Stream](#)

The stream to read the serialized data from.

Returns

[LoudsDictionary](#)

A new instance of [LoudsDictionary](#).

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidDataException](#)

The stream data is corrupted or in an unsupported format.

Serialize(LoudsDictionary, Stream, SerializationOptions?)

Serializes the state of the dictionary into a stream.

```
public static void Serialize(LoudsDictionary dictionary, Stream stream,  
KeyRecordDictionary.SerializationOptions? options = null)
```

Parameters

`dictionary` [LoudsDictionary](#)

The dictionary instance to serialize.

`stream` [Stream](#)

The stream to write the serialized data to.

`options` [KeyRecordDictionary.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is a custom binary format specific to this LOUDS implementation.

Exceptions

[ArgumentNullException](#)

`dictionary` or `stream` is null.

Class PrimitiveRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides a low-level, memory-efficient data store for variable-length byte records.

```
public sealed class PrimitiveRecordStore
```

Inheritance

[object](#) ← PrimitiveRecordStore

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This store uses a series of fixed-size byte arrays ("chunks") to avoid allocations on the Large Object Heap. It internally manages a system of linked lists, where each list is a sequence of records. The entire store can be serialized to and deserialized from a compressed, checksummed binary format.

Record Size Limit: Please note that the [Content](#) for any single record cannot exceed 4,096 bytes. This limit is enforced during operations such as adding or updating records.

Important Usage Note: This is an append-only style store. When records are removed (i.e., unlinked from their respective lists), the underlying space they occupied is **not** reclaimed or reused. As a result, memory usage will only grow as new records are added. To compact the store and reclaim the space from deleted records, the store must be rebuilt. The correct procedure is to create a new, empty store instance and transfer all valid records from the old store to the new one, for instance by iterating through a known set of root identifiers.

Methods

Clear()

Clears all data from the store and resets it to its initial state.

```
public void Clear()
```

Deserialize(byte[])

Deserializes a store from a byte array.

```
public static PrimitiveRecordStore Deserialize(byte[] data)
```

Parameters

data [byte](#)[]

The byte array containing the serialized data.

Returns

[PrimitiveRecordStore](#)

A new instance of [PrimitiveRecordStore](#).

Exceptions

[ArgumentNullException](#)

data is null.

[InvalidDataException](#)

The data is in an unsupported format or is corrupted.

Deserialize(Stream)

Deserializes a store from a stream.

```
public static PrimitiveRecordStore Deserialize(Stream stream)
```

Parameters

stream [Stream](#)

The stream to read the serialized data from.

Returns

[PrimitiveRecordStore](#)

A new instance of [PrimitiveRecordStore](#).

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidDataException](#)

The data is in an unsupported format or is corrupted.

Deserialize(string)

Deserializes a store from a file.

```
public static PrimitiveRecordStore Deserialize(string file)
```

Parameters

[file string](#)

The path of the file to read from.

Returns

[PrimitiveRecordStore](#)

A new instance of [PrimitiveRecordStore](#).

Exceptions

[ArgumentNullException](#)

`file` is null.

[ArgumentException](#)

`file` is empty or whitespace.

[InvalidDataException](#)

The data is in an unsupported format or is corrupted.

GetRecordAccess(int)

Gets a [PrimitiveRecordStore.RecordAccess](#) handle for a linked list of records.

```
public PrimitiveRecordStore.RecordAccess GetRecordAccess(int identifier = 0)
```

Parameters

identifier [int](#)

The identifier of the record list. Specify 0 to create a new list and get its identifier.

Returns

[PrimitiveRecordStore.RecordAccess](#)

A [PrimitiveRecordStore.RecordAccess](#) object to manage the specified record list.

Exceptions

[ArgumentOutOfRangeException](#)

identifier is negative.

[ArgumentException](#)

The specified **identifier** is invalid or does not exist.

Serialize(PrimitiveRecordStore, SerializationOptions?)

Serializes the specified store into a byte array.

```
public static byte[] Serialize(PrimitiveRecordStore store,  
PrimitiveRecordStore.SerializationOptions? options = null)
```

Parameters

store [PrimitiveRecordStore](#)

The store to serialize.

options [PrimitiveRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Returns

[byte\[\]](#)

A byte array containing the serialized data.

Exceptions

[ArgumentNullException](#)

`store` is null.

Serialize(PrimitiveRecordStore, Stream, SerializationOptions?)

Serializes the specified store into a stream.

```
public static void Serialize(PrimitiveRecordStore store, Stream stream,  
    PrimitiveRecordStore.SerializationOptions? options = null)
```

Parameters

`store` [PrimitiveRecordStore](#)

The store to serialize.

`stream` [Stream](#)

The stream to write the serialized data to.

options [PrimitiveRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Exceptions

[ArgumentNullException](#)

`store` or `stream` is null.

Serialize(PrimitiveRecordStore, string, SerializationOptions?)

Serializes the specified store to a file.

```
public static void Serialize(PrimitiveRecordStore store, string file,  
PrimitiveRecordStore.SerializationOptions? options = null)
```

Parameters

`store` [PrimitiveRecordStore](#)

The store to serialize.

`file` [string](#)

The path of the file to create.

`options` [PrimitiveRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Exceptions

[ArgumentNullException](#)

`store` or `file` is null.

[ArgumentException](#)

`file` is empty or whitespace.

Class PrimitiveRecordStore.Record

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Represents a handle to a single record within the store.

```
public sealed class PrimitiveRecordStore.Record
```

Inheritance

[object](#) ← PrimitiveRecordStore.Record

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This object is a proxy that provides methods to read, update, and navigate the record's data and relationships. Operations performed on this object modify the underlying data in the parent [PrimitiveRecordStore](#).

Properties

Actual

Gets the actual size of the record's content in bytes.

```
public int Actual { get; }
```

Property Value

[int](#)

Capacity

Gets the total allocated storage capacity for the record's content in bytes.

```
public int Capacity { get; }
```

Property Value

[int ↗](#)

ExByte

Gets or sets an extra, user-definable byte of metadata associated with this record. The value must be in the range of 0 to 255.

```
public int ExByte { get; set; }
```

Property Value

[int ↗](#)

Exceptions

[ArgumentOutOfRangeException ↗](#)

The assigned value is less than 0 or greater than 255.

Identifier

Gets the unique, persistent identifier for this record within the store.

```
public int Identifier { get; }
```

Property Value

[int ↗](#)

Next

Gets the next record in the linked list, or null if this is the last record.

```
public PrimitiveRecordStore.Record? Next { get; }
```

Property Value

[PrimitiveRecordStore.Record](#)

Methods

Clear()

Clears the content of the record, setting its length to zero.

```
public void Clear()
```

InsertAfter(ReadOnlySpan<byte>)

Inserts a new record with the specified content immediately after this record in the list.

```
public PrimitiveRecordStore.Record InsertAfter(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record to insert.

Returns

[PrimitiveRecordStore.Record](#)

A [PrimitiveRecordStore.Record](#) handle for the newly inserted record.

InsertBefore(ReadOnlySpan<byte>)

Inserts a new record with the specified content immediately before this record in the list.

```
public PrimitiveRecordStore.Record InsertBefore(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record to insert.

Returns

[PrimitiveRecordStore.Record](#)

A [PrimitiveRecordStore.Record](#) handle for the newly inserted record.

Read()

Reads the content of the record.

```
public ReadOnlySpan<byte> Read()
```

Returns

[ReadOnlySpan<byte>](#)

A read-only span of bytes representing the record's content.

Remove()

Removes this record from the linked list it belongs to.

```
public void Remove()
```

Update(ReadOnlySpan<byte>)

Updates the content of the record.

```
public void Update(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan](#) <[byte](#)>

The new content for the record.

Class PrimitiveRecordStore.RecordAccess

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides access to a linked list of records within a [PrimitiveRecordStore](#).

```
public sealed class PrimitiveRecordStore.RecordAccess :  
    IEnumerable<PrimitiveRecordStore.Record>, IEnumerable
```

Inheritance

[object](#) ← PrimitiveRecordStore.RecordAccess

Implements

[IEnumerable](#) <[PrimitiveRecordStore.Record](#)>, [IEnumerable](#)

Inherited Members

[object.Equals\(object\)](#), [object.Equals\(object, object\)](#), [object.GetHashCode\(\)](#), [object.GetType\(\)](#),
[object.ReferenceEquals\(object, object\)](#), [object.ToString\(\)](#)

Remarks

This class implements [IEnumerable<T>](#) to allow iterating over the records in the list. The collection will throw an [InvalidOperationException](#) if modified during enumeration.

Properties

Identifier

Gets the identifier for the head of the linked list that this object accesses.

```
public int Identifier { get; }
```

Property Value

[int](#)

Store

Gets the parent [PrimitiveRecordStore](#) that this accessor belongs to.

```
public PrimitiveRecordStore Store { get; }
```

Property Value

[PrimitiveRecordStore](#)

Methods

Add(ReadOnlySpan<byte>)

Adds a new record with the specified content to the end of the list.

```
public PrimitiveRecordStore.Record Add(ReadOnlySpan<byte> content)
```

Parameters

content [ReadOnlySpan<byte>](#)

The content of the new record.

Returns

[PrimitiveRecordStore.Record](#)

A [PrimitiveRecordStore.Record](#) handle for the newly added record.

Exceptions

[InvalidOperationException](#)

The operation is not supported for this accessor instance.

[ArgumentOutOfRangeException](#)

The length of **content** exceeds the maximum allowed size (4096 bytes).

Clear()

Removes all records from this list.

```
public void Clear()
```

Exceptions

[InvalidOperationException](#)

The operation is not supported for this accessor instance.

GetEnumerator()

Returns an enumerator that iterates through the records in the list.

```
public IEnumarator<PrimitiveRecordStore.Record> GetEnumerator()
```

Returns

[IEnumarator](#)<[PrimitiveRecordStore.Record](#)>

An enumerator for this record list.

Class PrimitiveRecordStore.SerializationOptions

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Provides options to control the serialization process for data store.

```
public class PrimitiveRecordStore.SerializationOptions
```

Inheritance

[object](#) ← PrimitiveRecordStore.SerializationOptions

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Properties

CompressionLevel

Gets or sets the compression level to use for serialization.

```
public CompressionLevel CompressionLevel { get; set; }
```

Property Value

[CompressionLevel](#)

Remarks

Higher compression levels can result in smaller file sizes but may take longer to process. Defaults to [Fastest](#) for a balance of speed and size.

Default

Gets a singleton instance of [PrimitiveRecordStore.SerializationOptions](#) with default values.

```
public static PrimitiveRecordStore.SerializationOptions Default { get; }
```

Property Value

[PrimitiveRecordStore.SerializationOptions](#)

Remarks

Use this property to avoid creating a new options object when default settings are sufficient.

Class RankSelectBitSet

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

An immutable bit set optimized for high-performance Rank and Select operations.

```
public sealed class RankSelectBitSet : ImmutableBitSet
```

Inheritance

[object](#) ← [ImmutableBitSet](#) ← RankSelectBitSet

Inherited Members

[ImmutableBitSet.Buffer](#) , [ImmutableBitSet.Count](#) , [ImmutableBitSet.this\[int\]](#) , [ImmutableBitSet.At\(int\)](#) ,
[ImmutableBitSet.ToRankSelect\(bool\)](#) , [ImmutableBitSet.ToRankSelect\(ImmutableBitSet, bool\)](#) ,
[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This data structure uses auxiliary indexes (lookup tables) to perform Rank (counting bits) and Select (finding the n-th bit) operations in near-constant time, making it suitable for succinct data structures like LOUDS Tries.

Constructors

RankSelectBitSet(ulong[], int)

An immutable bit set optimized for high-performance Rank and Select operations.

```
public RankSelectBitSet(ulong[] buffer, int count)
```

Parameters

buffer [ulong](#)[]

The underlying ulong array that stores the bits.

count [int](#)

The total number of bits in the set.

Remarks

This data structure uses auxiliary indexes (lookup tables) to perform Rank (counting bits) and Select (finding the n-th bit) operations in near-constant time, making it suitable for succinct data structures like LOUDS Tries.

Methods

CreateAuxDir(ImmutableBitSet)

Creates the auxiliary directories required for fast Rank and Select operations from a given bit set.

```
public static (int[], short[], int[]) CreateAuxDir(ImmutableBitSet bitSet)
```

Parameters

bitSet [ImmutableBitSet](#)

The immutable bit set to process.

Returns

[\(int\[\], short\[\], int\[\]\)](#)

A tuple containing the generated directories for rank and select.

GetAuxDir()

Gets the pre-calculated auxiliary directories for Rank and Select operations.

```
public (int[], short[], int[]) GetAuxDir()
```

Returns

[\(int\[\], short\[\], int\[\]\)](#)

A tuple containing the rank primary directory, rank secondary directory, and the select directory.

LastRank1()

Gets the total number of set bits (1s) in the entire bit set.

```
public int LastRank1()
```

Returns

[int ↗](#)

The total count of set bits.

Rank0(int)

Calculates the rank of a bit '0' at a specified position. Rank0 is the total number of unset bits (0s) up to, but not including, the given position [k](#).

```
public int Rank0(int k)
```

Parameters

[k](#) [int ↗](#)

The zero-based position index.

Returns

[int ↗](#)

The number of unset bits before position [k](#).

Rank1(int)

Calculates the rank of a bit '1' at a specified position. Rank is the total number of set bits (1s) up to and including the given position [k](#).

```
public int Rank1(int k)
```

Parameters

`k` `int` ↗

The zero-based position index.

Returns

`int` ↗

The number of set bits up to and including position `k`.

Select0(int)

Finds the position of the k-th unset bit (0).

```
public int Select0(int k)
```

Parameters

`k` `int` ↗

The one-based rank of the unset bit to find (e.g., `k=1` for the first '0').

Returns

`int` ↗

The zero-based index of the k-th unset bit, or -1 if not found.

Select1(int)

Finds the position of the k-th set bit (1).

```
public int Select1(int k)
```

Parameters

`k` `int` ↗

The one-based rank of the set bit to find (e.g., k=1 for the first '1').

Returns

[int](#)

The zero-based index of the k-th set bit, or -1 if not found.

SetAuxDir((int[], short[], int[]))

Sets the pre-calculated auxiliary directories for Rank and Select operations.

```
public void SetAuxDir((int[], short[], int[]) auxDir)
```

Parameters

auxDir ([int](#)[], [short](#)[], [int](#) [])

A tuple containing the rank primary directory, rank secondary directory, and the select directory.

Class ScapegoatTreeRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [BinaryTreeRecordStore](#) that uses a self-balancing Scapegoat tree.

```
public sealed class ScapegoatTreeRecordStore : BinaryTreeRecordStore, ICloneable
```

Inheritance

[object](#) ↗ ← [BasicRecordStore](#) ← [BinaryTreeRecordStore](#) ← ScapegoatTreeRecordStore

Implements

[ICloneable](#) ↗

Inherited Members

[BinaryTreeRecordStore.Clear\(\)](#) , [BinaryTreeRecordStore.Contains\(int\)](#) ,
[BinaryTreeRecordStore.GetRecordAccess\(int, out bool\)](#) ,
[BinaryTreeRecordStore.TryGetRecordAccess\(int, out BasicRecordStore.RecordAccess\)](#) ,
[BinaryTreeRecordStore.Enumerate\(\)](#) , [BinaryTreeRecordStore.PrintTree\(TextWriter\)](#) ,
[BasicRecordStore.Serialize<T>\(T, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, string, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, Stream, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Deserialize<T>\(byte\[\]\)](#) , [BasicRecordStore.Deserialize<T>\(string\)](#) ,
[BasicRecordStore.Deserialize<T>\(Stream\)](#) , [BasicRecordStore.Add\(int\)](#) ,
[BasicRecordStore.GetRecordAccess\(int\)](#) , [object.Equals\(object\)](#) ↗ , [object.Equals\(object, object\)](#) ↗ ,
[object.GetHashCode\(\)](#) ↗ , [object.GetType\(\)](#) ↗ , [object.ReferenceEquals\(object, object\)](#) ↗ ,
[object.ToString\(\)](#) ↗

Remarks

A Scapegoat tree is a self-balancing binary search tree that provides amortized time efficiency. Instead of rebalancing on every operation, it rebuilds subtrees only when an insertion or deletion causes a node (the "scapegoat") to become too unbalanced. Note: This implementation can be slow on certain operations that trigger a full subtree rebuild and is generally not recommended for performance-critical applications.

Serialization Limits: The binary serialization format for this class imposes certain constraints on the data. Exceeding these limits will result in an [InvalidOperationException](#) ↗ during serialization.

- **Max Records per List:** A single identifier can have a maximum of 16,777,215 records in its linked list.

- **Max Record Content Size:** The `Content` byte array of any single record cannot exceed 65,535 bytes.

Methods

Clone()

Creates a deep copy of the [ScapegoatTreeRecordStore](#).

```
public object Clone()
```

Returns

[object](#)

A new [ScapegoatTreeRecordStore](#) instance with the same structure and record data as the original.

Remarks

The method creates a new tree and copies all records, ensuring that the new store is independent of the original.

Deserialize(Stream)

Deserializes a [ScapegoatTreeRecordStore](#) from a stream.

```
public static ScapegoatTreeRecordStore Deserialize(Stream stream)
```

Parameters

`stream` [Stream](#)

The stream to read the serialized data from.

Returns

[ScapegoatTreeRecordStore](#)

A new instance of [ScapegoatTreeRecordStore](#) reconstructed from the stream.

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidDataException](#)

The stream data is corrupted, in an unsupported format, or contains invalid values.

IsBalanced()

Overrides the base method to check if the tree conforms to the alpha-weight-balanced property of a tree.

```
public override bool IsBalanced()
```

Returns

[bool](#)

true if no subtree violates the alpha-weight balance condition; otherwise, false.

Remove(int)

Removes the node with the specified identifier from the tree. May trigger a rebuild of the entire tree if the number of nodes drops significantly.

```
public override void Remove(int identifier)
```

Parameters

`identifier` [int](#)

The identifier of the node to remove.

Exceptions

[ArgumentOutOfRangeException](#)

`identifier` is [MinValue](#).

Serialize(ScapegoatTreeRecordStore, Stream, Serialization Options?)

Serializes the entire state of the tree store into a stream.

```
public static void Serialize(ScapegoatTreeRecordStore store, Stream stream,  
BasicRecordStore.SerializationOptions? options = null)
```

Parameters

`store` [ScapegoatTreeRecordStore](#)

The [ScapegoatTreeRecordStore](#) instance to serialize.

`stream` [Stream](#)

The stream to write the serialized data to.

`options` [BasicRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is specific to this tree implementation, using Brotli compression and an XxHash32 checksum for data integrity.

Exceptions

[ArgumentNullException](#)

`store` or `stream` is null.

Class TreapRecordStore

Namespace: [BelNytheraSeiche.TrieDictionary](#).

Assembly: BelNytheraSeiche.TrieDictionary.dll

A concrete implementation of [BinaryTreeRecordStore](#) that uses a Treap.

```
public class TreapRecordStore : BinaryTreeRecordStore, ICloneable
```

Inheritance

[object](#) ↗ ← [BasicRecordStore](#) ← [BinaryTreeRecordStore](#) ← TreapRecordStore

Implements

[ICloneable](#) ↗

Inherited Members

[BinaryTreeRecordStore.Clear\(\)](#) , [BinaryTreeRecordStore.Contains\(int\)](#) ,
[BinaryTreeRecordStore.GetRecordAccess\(int, out bool\)](#) ,
[BinaryTreeRecordStore.TryGetRecordAccess\(int, out BasicRecordStore.RecordAccess\)](#) ,
[BinaryTreeRecordStore.Enumerate\(\)](#) , [BinaryTreeRecordStore.PrintTree\(TextWriter\)](#) ,
[BasicRecordStore.Serialize<T>\(T, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, string, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Serialize<T>\(T, Stream, BasicRecordStore.SerializationOptions\)](#) ,
[BasicRecordStore.Deserialize<T>\(byte\[\]\)](#) , [BasicRecordStore.Deserialize<T>\(string\)](#) ,
[BasicRecordStore.Deserialize<T>\(Stream\)](#) , [BasicRecordStore.Add\(int\)](#) ,
[BasicRecordStore.GetRecordAccess\(int\)](#) , [object.Equals\(object\)](#) ↗ , [object.Equals\(object, object\)](#) ↗ ,
[object.GetHashCode\(\)](#) ↗ , [object.GetType\(\)](#) ↗ , [object.MemberwiseClone\(\)](#) ↗ ,
[object.ReferenceEquals\(object, object\)](#) ↗ , [object.ToString\(\)](#) ↗

Remarks

A Treap is a randomized binary search tree. It maintains the binary search tree property for its keys (identifiers) and the max-heap property for randomly assigned priorities. This combination maintains balance with high probability, providing good average-case performance for insertions, deletions, and lookups.

Serialization Limits: The binary serialization format for this class imposes certain constraints on the data. Exceeding these limits will result in an [InvalidOperationException](#) ↗ during serialization.

- **Max Records per List:** A single identifier can have a maximum of 16,777,215 records in its linked list.
- **Max Record Content Size:** The [Content](#) byte array of any single record cannot exceed 65,535 bytes.

Methods

Clone()

Creates a deep copy of the [TreapRecordStore](#).

```
public virtual object Clone()
```

Returns

[object](#)

A new [TreapRecordStore](#) instance with the same record data as the original.

Remarks

The method creates a new tree and copies all records. The new tree will have newly randomized priorities for its nodes, so its internal structure may differ from the original, but it will be functionally equivalent.

Deserialize(Stream)

Deserializes a [TreapRecordStore](#) from a stream.

```
public static TreapRecordStore Deserialize(Stream stream)
```

Parameters

[stream](#) [Stream](#)

The stream to read the serialized data from.

Returns

[TreapRecordStore](#)

A new instance of [TreapRecordStore](#) reconstructed from the stream.

Exceptions

[ArgumentNullException](#)

`stream` is null.

[InvalidDataException](#)

The stream data is corrupted, in an unsupported format, or contains invalid values.

IsBalanced()

Overrides the base method to check if the tree is a valid tree.

```
public override bool IsBalanced()
```

Returns

[bool](#)

true if the tree satisfies both the binary search tree property (for identifiers) and the max-heap property (for priorities); otherwise, false.

Remove(int)

Removes the node with the specified identifier from the tree, performing rotations to maintain the heap property before removal.

```
public override void Remove(int identifier)
```

Parameters

`identifier` [int](#)

The identifier of the node to remove.

Exceptions

[ArgumentOutOfRangeException](#)

`identifier` is [MinValue](#).

Serialize(TreapRecordStore, Stream, SerializationOptions?)

Serializes the entire state of the tree, including node priorities, into a stream.

```
public static void Serialize(TreapRecordStore store, Stream stream,  
BasicRecordStore.SerializationOptions? options = null)
```

Parameters

store [TreapRecordStore](#)

The [TreapRecordStore](#) instance to serialize.

stream [Stream](#)

The stream to write the serialized data to.

options [BasicRecordStore.SerializationOptions](#)

Options to control the serialization process. If null, the settings from [Default](#) will be used.

Remarks

The serialization format is specific to this tree implementation, using Brotli compression and an XxHash32 checksum for data integrity.

Exceptions

[ArgumentNullException](#)

store or **stream** is null.

Class ValueBuffer<T>

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Represents a buffer for value types, implemented using a list of array chunks.

```
public sealed class ValueBuffer<T> : ICollection<T>, IEnumerable<T>, IEnumerable where T : struct
```

Type Parameters

T

The type of element, which must be a struct.

Inheritance

[object](#) ← ValueBuffer<T>

Implements

[ICollection](#)<T>, [IEnumerable](#)<T>, [IEnumerable](#)

Inherited Members

[object.Equals\(object\)](#), [object.Equals\(object, object\)](#), [object.GetHashCode\(\)](#), [object.GetType\(\)](#),
[object.ReferenceEquals\(object, object\)](#), [object.ToString\(\)](#)

Remarks

This class is designed to manage large collections of value types without allocating on the Large Object Heap (LOH). It achieves this by storing elements in a series of smaller array "chunks". The size of these chunks, specified by [ElementsPerChunk](#), must be a power of 2.

Constructors

ValueBuffer(int, bool)

Initializes a new instance of the [ValueBuffer<T>](#) class.

```
public ValueBuffer(int elementsPerChunk, bool extendAutomatically = false)
```

Parameters

`elementsPerChunk` [int](#)

The size of each internal array chunk. This value must be a power of 2.

`extendAutomatically` [bool](#)

A value indicating whether to automatically extend the buffer's capacity when an out-of-bounds index is accessed.

Exceptions

[ArgumentOutOfRangeException](#)

`elementsPerChunk` is not positive.

[ArgumentException](#)

`elementsPerChunk` is not a power of 2.

Properties

Capacity

Gets the total number of elements that can be stored across all currently allocated chunks.

```
public int Capacity { get; }
```

Property Value

[int](#)

Count

Gets the number of elements contained in the [ValueBuffer<T>](#). This property is an implementation for the [ICollection<T>](#) interface and is an alias for the [Used](#) property.

```
public int Count { get; }
```

Property Value

[int ↗](#)

ElementsPerChunk

Gets the size of each internal array chunk.

```
public int ElementsPerChunk { get; }
```

Property Value

[int ↗](#)

ExtendAutomatically

Gets a value indicating whether the buffer will automatically allocate new chunks when an index outside the current capacity is accessed.

```
public bool ExtendAutomatically { get; }
```

Property Value

[bool ↗](#)

IsReadOnly

Gets a value indicating whether the [ValueBuffer<T>](#) is read-only.

```
public bool IsReadOnly { get; }
```

Property Value

[bool ↗](#)

this[int]

Gets or sets the element at the specified index.

```
public ref T this[int index] { get; }
```

Parameters

index [int](#)

The zero-based index of the element to get or set.

Property Value

T

A reference to the element at the specified index.

Remarks

Accessing an index greater than or equal to the current [Used](#) count will update the count to [index + 1](#). If [ExtendAutomatically](#) is true, accessing an index beyond the current [Capacity](#) will allocate new chunks.

Exceptions

[ArgumentOutOfRangeException](#)

Thrown if [index](#) is negative, or if [index](#) is greater than or equal to [Capacity](#) and [ExtendAutomatically](#) is false.

NumberOfChunks

Gets the number of internal array chunks that are currently allocated.

```
public int NumberOfChunks { get; }
```

Property Value

[int](#)

Used

Gets the number of elements that are considered to be in use within the buffer. This value is updated when an element is written to an index greater than the current used count.

```
public int Used { get; }
```

Property Value

[int ↗](#)

Methods

Add(T)

Adds an element to the end of the [ValueBuffer<T>](#).

```
public void Add(T value)
```

Parameters

value T

The element to add.

AppendChunkDirectly(T[])

Appends a pre-allocated array chunk directly to the internal list of buffers, increasing the capacity.

```
public void AppendChunkDirectly(T[] chunk)
```

Parameters

chunk T[]

The array to append. Its length must be exactly equal to [ElementsPerChunk](#).

Remarks

This is an advanced optimization method that avoids an array allocation and copy by using a caller-provided array.

Exceptions

[ArgumentNullException](#)

`chunk` is null.

[ArgumentException](#)

The length of `chunk` is not equal to [ElementsPerChunk](#).

Clear()

Removes all elements from the [ValueBuffer<T>](#) and releases all internal array chunks.

```
public void Clear()
```

Contains(T)

Determines whether the [ValueBuffer<T>](#) contains a specific value.

```
public bool Contains(T item)
```

Parameters

`item` T

The object to locate in the [ValueBuffer<T>](#).

Returns

[bool](#)

true if item is found in the [ValueBuffer<T>](#); otherwise, false.

CopyTo(T[], int)

Copies the elements of the [ValueBuffer<T>](#) to an [Array](#), starting at a particular [Array](#) index.

```
public void CopyTo(T[] array, int arrayIndex)
```

Parameters

array `T[]`

The one-dimensional [Array](#) that is the destination of the elements copied from [ValueBuffer<T>](#).

arrayIndex `int`

The zero-based index in **array** at which copying begins.

Exceptions

[ArgumentNullException](#)

array is null.

[ArgumentOutOfRangeException](#)

arrayIndex is less than 0.

[ArgumentException](#)

The number of elements in the source buffer is greater than the available space from **arrayIndex** to the end of the destination **array**.

EnumerateChunks()

Returns an enumerable collection of the internal array chunks.

```
public IEnumerable<T[]> EnumerateChunks()
```

Returns

[IEnumerable](#)<`T[]`>

An [IEnumerable](#)<`T`> (`T` is an array) that allows iteration over the raw internal buffers.

Remarks

This method is intended for advanced scenarios where direct read-only access to the underlying chunks is required.

ExtendCapacity(int)

Ensures that the capacity of this buffer is at least the specified value.

```
public int ExtendCapacity(int minCapacity)
```

Parameters

minCapacity [int](#)

The minimum required capacity.

Returns

[int](#)

The new capacity of the buffer, which will be a multiple of [ElementsPerChunk](#).

Exceptions

[ArgumentOutOfRangeException](#)

minCapacity is negative.

Fill(T, int, int)

Fills a range of elements in the buffer with a specified value.

```
public void Fill(T value, int index, int count)
```

Parameters

value T

The value to assign to each element in the range.

`index` [int](#)

The zero-based starting index of the range to fill.

`count` [int](#)

The number of elements in the range to fill.

Exceptions

[ArgumentOutOfRangeException](#)

`index` or `count` is negative.

[ArgumentException](#)

The sum of `index` and `count` is greater than the buffer's capacity and [ExtendAutomatically](#) is false.

GetEnumerator()

Returns an enumerator that iterates through the used elements in the buffer.

```
public IEnumrator<T> GetEnumerator()
```

Returns

[IEnumrator](#)<T>

An enumerator for the [ValueBuffer<T>](#).

Remove(T)

Finds the first occurrence of an item and replaces it with the default value of type `T`.

```
public bool Remove(T item)
```

Parameters

`item` `T`

The item to locate and replace.

Returns

[bool](#)

true if the item was found and replaced; otherwise, false.

Remarks

This method does not actually remove the element in a way that would shift subsequent elements. It only overwrites the found element with `default(T)`. The [Count](#) and [Used](#) properties are not changed by this operation.

SetUsedDirectly(int, bool)

Directly sets the number of used elements and optionally shrinks the buffer's capacity.

```
public void SetUsedDirectly(int used, bool shrinkAutomatically = false)
```

Parameters

`used` [int](#)

The new count of used elements. This value must be between 0 and [Capacity](#).

`shrinkAutomatically` [bool](#)

If true, deallocates unused array chunks from the end of the buffer to fit the new used count.

Remarks

This is an advanced method and should be used with caution. Setting an incorrect value can lead to an inconsistent state or data corruption.

Exceptions

[ArgumentOutOfRangeException](#)

`used` is negative or greater than [Capacity](#).

ToArray()

Copies the used elements from the [ValueBuffer<T>](#) to a new, single contiguous array.

```
public T[] ToArray()
```

Returns

T[]

A new array containing the elements from the buffer.

Class Xoroshiro128PlusPlus

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Represents a 64-bit pseudo-random number generator based on the xoroshiro128++ algorithm.

```
public class Xoroshiro128PlusPlus : ICloneable
```

Inheritance

[object](#) ← Xoroshiro128PlusPlus

Implements

[ICloneable](#)

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This generator is not cryptographically secure.

Constructors

Xoroshiro128PlusPlus()

Initializes a new instance of the [Xoroshiro128PlusPlus](#) class, using a unique seed value derived from a new GUID.

```
public Xoroshiro128PlusPlus()
```

Xoroshiro128PlusPlus(Xoroshiro128PlusPlus)

Initializes a new instance of the [Xoroshiro128PlusPlus](#) class by copying the state from another instance.

```
public Xoroshiro128PlusPlus(Xoroshiro128PlusPlus obj)
```

Parameters

obj [Xoroshiro128PlusPlus](#)

The [Xoroshiro128PlusPlus](#) instance to copy the state from.

Remarks

This constructor is primarily intended for replicating the state of the generator for parallel processing scenarios. After creating a copy, call the [Jump\(\)](#) method on one of the instances to ensure that each generator produces a non-overlapping sequence of random numbers.

Exceptions

[ArgumentNullException](#)

obj is null.

Xoroshiro128PlusPlus(ulong)

Initializes a new instance of the [Xoroshiro128PlusPlus](#) class, using the specified seed value.

```
public Xoroshiro128PlusPlus(ulong seed)
```

Parameters

seed [ulong](#)

A number used to calculate a starting value for the pseudo-random number sequence.

Methods

Clone()

Creates a new object that is a shallow copy of the current instance.

```
public object Clone()
```

Returns

[object](#)

A new object that is a shallow copy of this instance.

Remarks

This constructor is primarily intended for replicating the state of the generator for parallel processing scenarios. After creating a copy, call the [Jump\(\)](#) method on one of the instances to ensure that each generator produces a non-overlapping sequence of random numbers.

Jump()

Advances the state of the generator by 2^{64} steps.

```
public void Jump()
```

Remarks

This is equivalent to generating 2^{64} random numbers and discarding them, but it is executed much faster. It is useful for creating non-overlapping subsequences for parallel random number generation.

Next()

Returns a non-negative random integer.

```
public int Next()
```

Returns

[int](#)

A 32-bit signed integer that is greater than or equal to 0 and less than [MaxValue](#).

Next(int)

Returns a non-negative random integer that is less than the specified maximum.

```
public int Next(int maxValue)
```

Parameters

`maxValue` [int](#)

The exclusive upper bound of the random number to be generated. `maxValue` must be greater than or equal to 0.

Returns

[int](#)

A 32-bit signed integer that is greater than or equal to 0, and less than `maxValue`.

Remarks

If `maxValue` is 0, this method will always return 0.

Next(int, int)

Returns a random integer that is within a specified range.

```
public int Next(int minValue, int maxValue)
```

Parameters

`minValue` [int](#)

The inclusive lower bound of the random number returned.

`maxValue` [int](#)

The exclusive upper bound of the random number returned. `maxValue` must be greater than or equal to `minValue`.

Returns

[int](#)

A 32-bit signed integer greater than or equal to `minValue` and less than `maxValue`.

Remarks

If `minValue` equals `maxValue`, this method returns `minValue`.

Exceptions

[ArgumentOutOfRangeException](#)

`minValue` is greater than `maxValue`.

NextBytes(Span<byte>)

Fills the elements of a specified span of bytes with random numbers.

```
public void NextBytes(Span<byte> buffer)
```

Parameters

`buffer` [Span](#)<byte>

The span of bytes to fill with random numbers.

NextDouble()

Returns a random double-precision floating-point number that is greater than or equal to 0.0, and less than 1.0.

```
public double NextDouble()
```

Returns

[double](#)

A double-precision floating-point number that is greater than or equal to 0.0 and less than 1.0.

NextInt64()

Returns a non-negative random 64-bit integer.

```
public long NextInt64()
```

Returns

[long](#)

A 64-bit signed integer that is greater than or equal to 0 and less than [MaxValue](#).

NextInt64(long)

Returns a non-negative random 64-bit integer that is less than the specified maximum.

```
public long NextInt64(long maxValue)
```

Parameters

[maxValue](#) [long](#)

The exclusive upper bound of the random number to be generated. [maxValue](#) must be greater than or equal to 0.

Returns

[long](#)

A 64-bit signed integer that is greater than or equal to 0, and less than [maxValue](#).

Remarks

If [maxValue](#) is 0, this method will always return 0.

NextInt64(long, long)

Returns a random 64-bit integer that is within a specified range.

```
public long NextInt64(long minValue, long maxValue)
```

Parameters

`minValue` [long](#)

The inclusive lower bound of the random number returned.

`maxValue` [long](#)

The exclusive upper bound of the random number returned. `maxValue` must be greater than or equal to `minValue`.

Returns

[long](#)

A 64-bit signed integer greater than or equal to `minValue` and less than `maxValue`.

Remarks

If `minValue` equals `maxValue`, this method returns `minValue`.

Exceptions

[ArgumentOutOfRangeException](#)

`minValue` is greater than `maxValue`.

NextSingle()

Returns a random single-precision floating-point number that is greater than or equal to 0.0, and less than 1.0.

```
public float NextSingle()
```

Returns

[float](#)

A single-precision floating-point number that is greater than or equal to 0.0f and less than 1.0f.

Shuffle<T>(IList<T>)

Randomizes the order of the elements in a list.

```
public void Shuffle<T>(IList<T> values)
```

Parameters

values [IList](#)<T>

The list whose elements to shuffle.

Type Parameters

T

The type of the elements of the list.

Remarks

This method uses the Fisher-Yates shuffle algorithm.

Exceptions

[ArgumentNullException](#)

values is null.

Shuffle<T>(Span<T>)

Randomizes the order of the elements in a span.

```
public void Shuffle<T>(Span<T> values)
```

Parameters

values [Span](#)<T>

The span whose elements to shuffle.

Type Parameters

T

The type of the elements of the span.

Remarks

This method uses the Fisher-Yates shuffle algorithm.

Class Xoshiro256PlusPlus

Namespace: [BelNytheraSeiche.TrieDictionary](#)

Assembly: BelNytheraSeiche.TrieDictionary.dll

Represents a 64-bit pseudo-random number generator based on the xoshiro256++ algorithm.

```
public class Xoshiro256PlusPlus : ICloneable
```

Inheritance

[object](#) ← Xoshiro256PlusPlus

Implements

[ICloneable](#)

Inherited Members

[object.Equals\(object\)](#) , [object.Equals\(object, object\)](#) , [object.GetHashCode\(\)](#) , [object.GetType\(\)](#) ,
[object.MemberwiseClone\(\)](#) , [object.ReferenceEquals\(object, object\)](#) , [object.ToString\(\)](#)

Remarks

This generator is not cryptographically secure.

Constructors

Xoshiro256PlusPlus()

Initializes a new instance of the [Xoshiro256PlusPlus](#) class, using a unique seed value derived from a new GUID.

```
public Xoshiro256PlusPlus()
```

Xoshiro256PlusPlus(Xoshiro256PlusPlus)

Initializes a new instance of the [Xoshiro256PlusPlus](#) class by copying the state from another instance.

```
public Xoshiro256PlusPlus(Xoshiro256PlusPlus obj)
```

Parameters

obj [Xoshiro256PlusPlus](#)

The [Xoshiro256PlusPlus](#) instance to copy the state from.

Remarks

This constructor is primarily intended for replicating the state of the generator for parallel processing scenarios. After creating a copy, call the [Jump\(\)](#) method on one of the instances to ensure that each generator produces a non-overlapping sequence of random numbers.

Exceptions

[ArgumentNullException](#)

obj is null.

Xoshiro256PlusPlus(ulong)

Initializes a new instance of the [Xoshiro256PlusPlus](#) class, using the specified seed value.

```
public Xoshiro256PlusPlus(ulong seed)
```

Parameters

seed [ulong](#)

A number used to calculate a starting value for the pseudo-random number sequence.

Methods

Clone()

Creates a new object that is a shallow copy of the current instance.

```
public object Clone()
```

Returns

[object](#)

A new object that is a shallow copy of this instance.

Remarks

This constructor is primarily intended for replicating the state of the generator for parallel processing scenarios. After creating a copy, call the [Jump\(\)](#) method on one of the instances to ensure that each generator produces a non-overlapping sequence of random numbers.

Jump()

Advances the state of the generator by 4^{64} steps.

```
public void Jump()
```

Remarks

This is equivalent to generating 4^{64} random numbers and discarding them, but it is executed much faster. It is useful for creating non-overlapping subsequences for parallel random number generation.

Next()

Returns a non-negative random integer.

```
public int Next()
```

Returns

[int](#)

A 32-bit signed integer that is greater than or equal to 0 and less than [MaxValue](#).

Next(int)

Returns a non-negative random integer that is less than the specified maximum.

```
public int Next(int maxValue)
```

Parameters

`maxValue` [int](#)

The exclusive upper bound of the random number to be generated. `maxValue` must be greater than or equal to 0.

Returns

[int](#)

A 32-bit signed integer that is greater than or equal to 0, and less than `maxValue`.

Remarks

If `maxValue` is 0, this method will always return 0.

Next(int, int)

Returns a random integer that is within a specified range.

```
public int Next(int minValue, int maxValue)
```

Parameters

`minValue` [int](#)

The inclusive lower bound of the random number returned.

`maxValue` [int](#)

The exclusive upper bound of the random number returned. `maxValue` must be greater than or equal to `minValue`.

Returns

[int](#)

A 32-bit signed integer greater than or equal to `minValue` and less than `maxValue`.

Remarks

If `minValue` equals `maxValue`, this method returns `minValue`.

Exceptions

[ArgumentOutOfRangeException](#)

`minValue` is greater than `maxValue`.

NextBytes(Span<byte>)

Fills the elements of a specified span of bytes with random numbers.

```
public void NextBytes(Span<byte> buffer)
```

Parameters

`buffer` [Span](#)<`byte`>

The span of bytes to fill with random numbers.

NextDouble()

Returns a random double-precision floating-point number that is greater than or equal to 0.0, and less than 1.0.

```
public double NextDouble()
```

Returns

[double](#)

A double-precision floating-point number that is greater than or equal to 0.0 and less than 1.0.

NextInt64()

Returns a non-negative random 64-bit integer.

```
public long NextInt64()
```

Returns

[long](#)

A 64-bit signed integer that is greater than or equal to 0 and less than [MaxValue](#).

NextInt64(int)

Returns a non-negative random 64-bit integer that is less than the specified maximum.

```
public long NextInt64(int maxValue)
```

Parameters

[maxValue](#) [int](#)

The exclusive upper bound of the random number to be generated. [maxValue](#) must be greater than or equal to 0.

Returns

[long](#)

A 64-bit signed integer that is greater than or equal to 0, and less than [maxValue](#).

Remarks

If [maxValue](#) is 0, this method will always return 0.

NextInt64(long, long)

Returns a random 64-bit integer that is within a specified range.

```
public long NextInt64(long minValue, long maxValue)
```

Parameters

`minValue` [long](#)

The inclusive lower bound of the random number returned.

`maxValue` [long](#)

The exclusive upper bound of the random number returned. `maxValue` must be greater than or equal to `minValue`.

Returns

[long](#)

A 64-bit signed integer greater than or equal to `minValue` and less than `maxValue`.

Remarks

If `minValue` equals `maxValue`, this method returns `minValue`.

Exceptions

[ArgumentOutOfRangeException](#)

`minValue` is greater than `maxValue`.

NextSingle()

Returns a random single-precision floating-point number that is greater than or equal to 0.0, and less than 1.0.

```
public float NextSingle()
```

Returns

[float](#)

A single-precision floating-point number that is greater than or equal to 0.0f and less than 1.0f.

Shuffle<T>(IList<T>)

Randomizes the order of the elements in a list.

```
public void Shuffle<T>(IList<T> values)
```

Parameters

values [IList](#)<T>

The list whose elements to shuffle.

Type Parameters

T

The type of the elements of the list.

Remarks

This method uses the Fisher-Yates shuffle algorithm.

Exceptions

[ArgumentNullException](#)

values is null.

Shuffle<T>(Span<T>)

Randomizes the order of the elements in a span.

```
public void Shuffle<T>(Span<T> values)
```

Parameters

values [Span](#)<T>

The span whose elements to shuffle.

Type Parameters

T

The type of the elements of the span.

Remarks

This method uses the Fisher-Yates shuffle algorithm.