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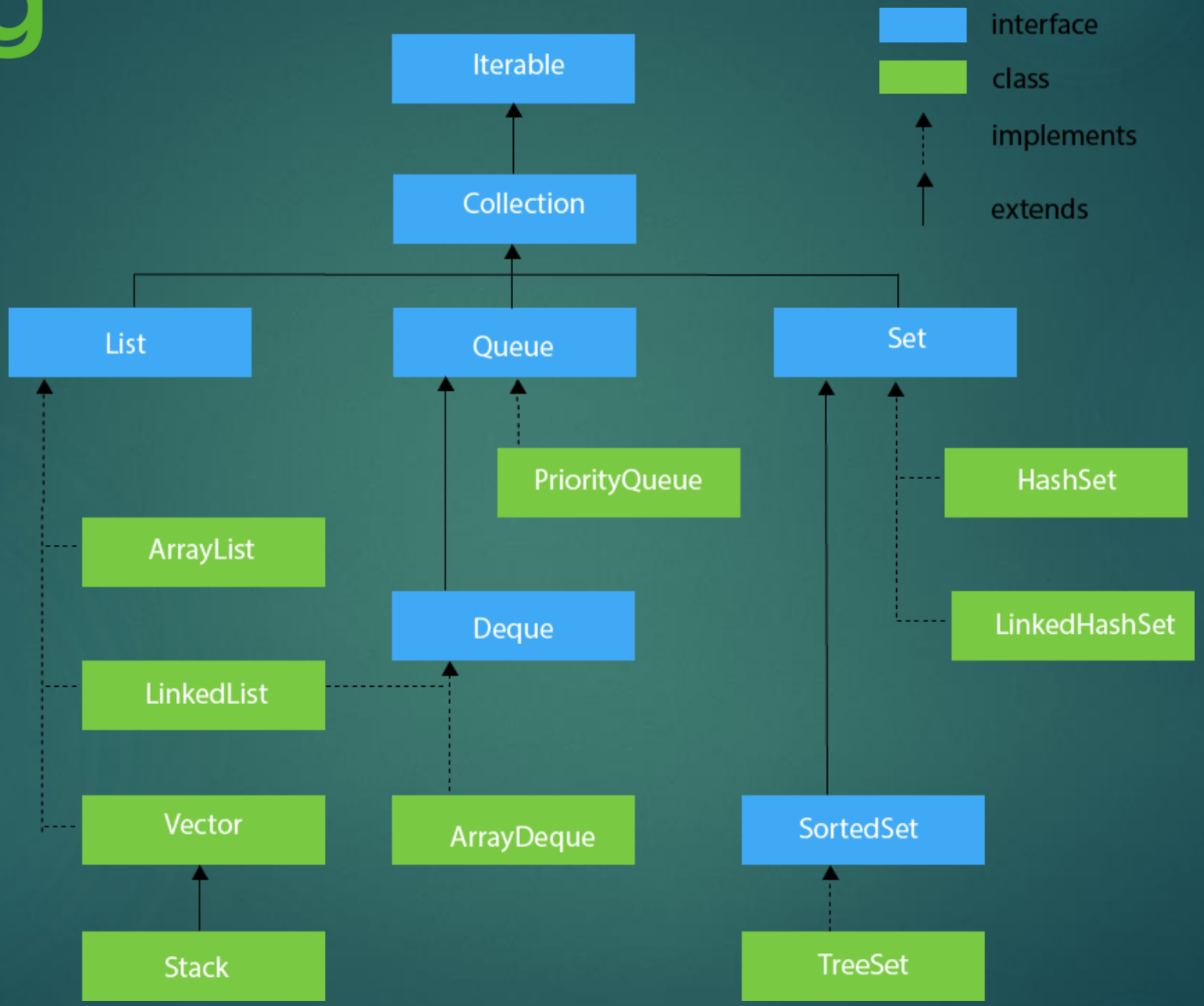


By Eslam Khder


# Set

In Java, both `HashSet` and `LinkedHashSet` implement the `Set` interface and are used to store unique elements. However, there are some key differences between the two in terms of ordering and performance characteristics.

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# Set

## 1. Ordering of Elements:

- `HashSet` : Does **not guarantee any specific order** of elements. It stores elements in an unordered manner. Internally, it uses a hash table, which doesn't maintain the order in which elements are inserted.
- `LinkedHashSet` : Maintains the **insertion order** of elements. It uses a combination of a hash table (like `HashSet` ) and a linked list to maintain the order in which elements were added to the set. This means the order of iteration will be the same as the order of insertion.

A **HashTable** in Java is a data structure that stores key-value pairs and allows efficient data retrieval based on the key. It is part of the **Java Collections Framework** and is found in the `java.util` package.

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# Set

## 2. Performance:

- `HashSet` : Typically, **faster** than `LinkedHashSet` for operations like `add()` , `remove()` , and `contains()` because it does not maintain any ordering, thus it has less overhead.
- `LinkedHashSet` : Slightly **slower** than `HashSet` because it maintains the linked list to preserve the insertion order, which adds some overhead to the operations. However, the difference is generally minimal unless you're working with large sets.


# Set

### 3. Memory Overhead:

- `HashSet` : Has less memory overhead since it only stores the hash table.
- `LinkedHashSet` : Uses more memory because it also maintains a linked list to preserve the order.

### 4. Use Case:

- `HashSet` : When you do not care about the order of elements and only care about uniqueness and fast access, `HashSet` is ideal.
- `LinkedHashSet` : When you need to maintain the order of insertion but still want the performance benefits of a hash-based set, `LinkedHashSet` is more appropriate.


# Set

## Summary of Differences:

| Feature | `HashSet` | `LinkedHashSet` |
|---|---|---|
| **Order** | No guaranteed order | Maintains insertion order |
| **Performance** | Faster (due to no linked list) | Slower (due to linked list overhead) |
| **Memory Overhead** | Lower (no linked list) | Higher (due to linked list) |
| **Use Case** | When order is not important | When order matters (insertion order) |

By Eslam Khder

# Vector


A `Vector` in Java is a **resizable array-based** data structure that implements the **List interface** and is **synchronized**, meaning it is **thread-safe** for concurrent access.

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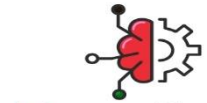
# Vector



## Key Features of `Vector`

1. **Dynamic Resizing:**
   - Unlike arrays, a `Vector` **automatically grows** when needed.
   - Default growth: **Doubles in size** when capacity is exceeded.
2. **Thread-Safe (Synchronized):**
   - Methods are **synchronized**, meaning only one thread can modify it at a time.
   - This makes it **slower** than `ArrayList` in a single-threaded environment.
3. **Implements `List` & Uses an Array:**
   - Internally, `Vector` uses an **array** for storage, similar to `ArrayList`.

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# Vector

🔹 `Vector` **vs.** `ArrayList`

| Feature | `Vector` 🚀 | `ArrayList` 🏎️ |
|---|---|---|
| **Thread-Safe?** | ✅ Yes (Synchronized) | ❌ No (Not Synchronized) |
| **Performance** | 🔻 Slower | ✅ Faster |
| **Growth Strategy** | Doubles in size | Increases by 50% |
| **Use Case** | Multi-threaded apps | Single-threaded apps |

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# PriorityQueue

## PriorityQueue in Java

A **PriorityQueue** in Java is a special type of queue where elements are processed based on their priority instead of the order they were added (FIFO).

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# ArrayDeque

ArrayDeque  is a resizable, array-based implementation of the Deque interface in Java. It allows elements to be added or removed from both ends (front and back), making it more versatile than Stack and Queue.

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# ArrayDeque

## Key Features of `ArrayDeque`

- **Implements `Deque` Interface** → Supports operations at both ends.
- **No Capacity Restrictions** → Automatically resizes when full.
- **Does Not Allow Null Elements** → Unlike some other collections.

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| Feature | `HashMap` | `Hashtable` |
| --- | --- | --- |
| **Thread Safety** | Not thread-safe (must synchronize manually if needed) | Thread-safe (synchronized methods) |
| **Performance** | Faster (no synchronization overhead) | Slower (due to synchronization) |

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