CSCI 132:
Basic Data Structures and Algorithms

More Java Constructs

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Fall 2023

Announcements

- Program 5 due **Sunday (12/10)**
- No lecture on Wednesday (Program 5 help session)
- Take some time this week to double check your grades
- Final Exam

  Wednesday December 13th

  2:00 PM – 3:50 PM

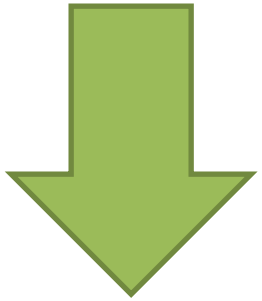
- Rubber Duck Extra credit screenshot due by Friday

- Fill out the course evaluation

Since the LinkedList class implements the Queue interface, it can be treated as a Queue object

```
import java.util.LinkedList;
import java.util.Queue;
```

```
LinkedList<String> queue = new LinkedList<String>();
```



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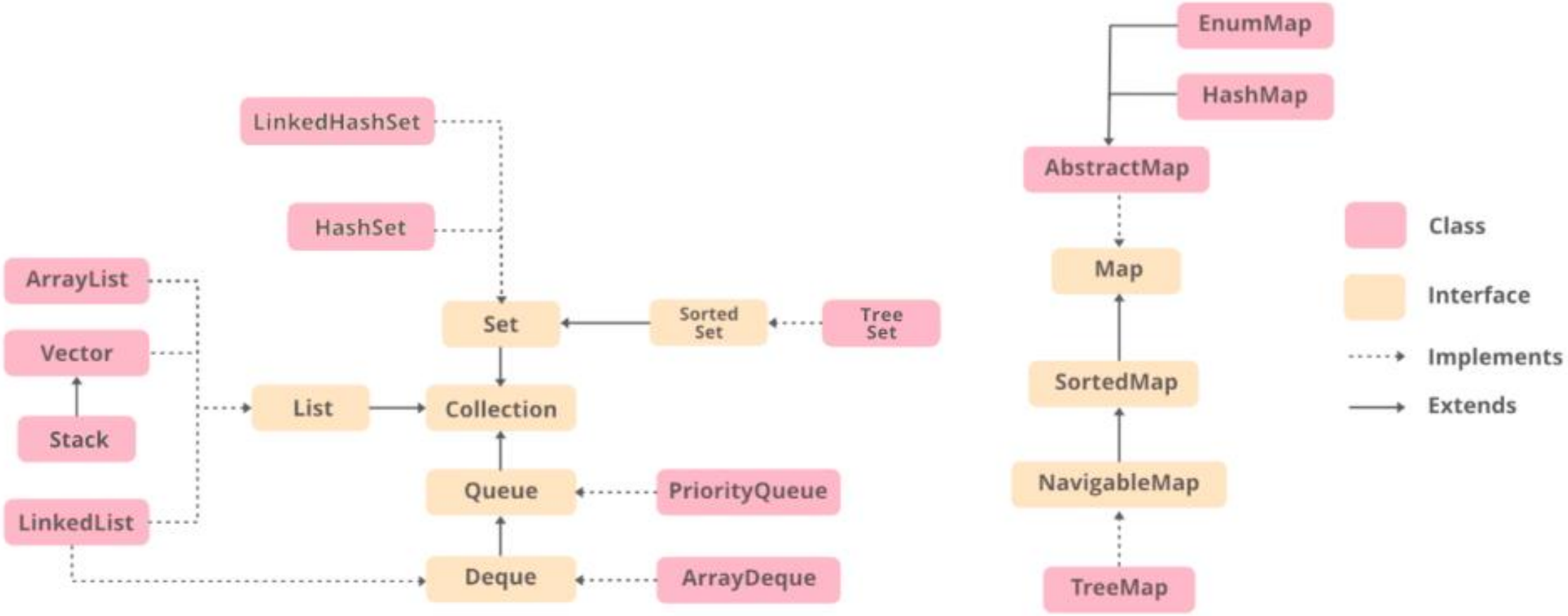
LinkedHashSet
HashSet
ArrayList
Vector
Stack
LinkedList
Set
Sorted Set
Tree Set
List
Collection
Queue
PriorityQueue
Deque
ArrayDeque
EnumMap
HashMap
AbstractMap
Map
SortedMap
NavigableMap
TreeMap
Class
Interface
Implements
Extends

Instead of writing many `if/else` statements, you can use the `switch` statement

The `switch` statement selects one of many code blocks to be executed

```
int day = 4;
switch (day) {
    case 1:
        System.out.println("Monday");
        break;
    case 2:
        System.out.println("Tuesday");
        break;
    case 3:
       System.out.println("Wednesday");
       break;
    default:
        System.out.println(“???");
```

These can be efficient when working with many possible conditions. They serve the same purpose as if statements, but are *slightly* more efficient

Java has a built-in `sort` method for Arrays

What sorting algorithm does it use?

https://docs.oracle.com/javase/8/docs/api/java/util/Arrays.html

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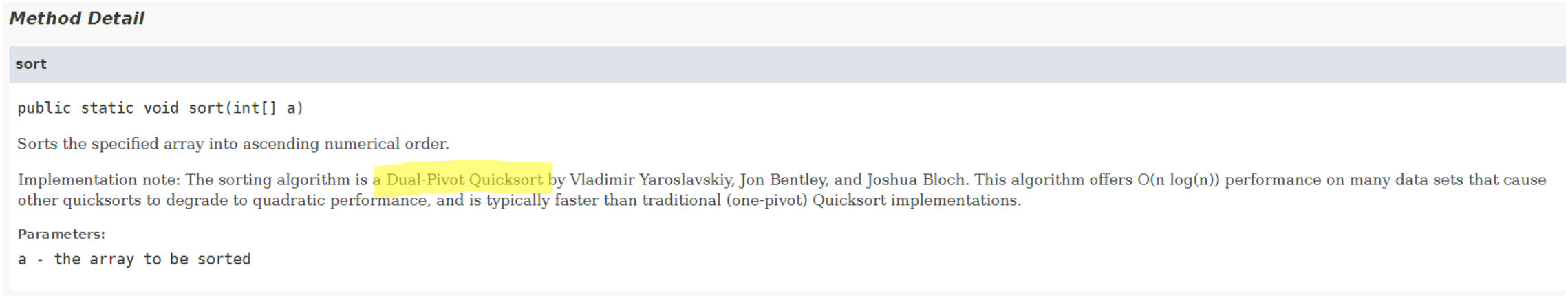

Method Detail

sort

```
public static void sort(int[] a)
```

Sorts the specified array into ascending numerical order.

Implementation note: The sorting algorithm is a Dual-Pivot Quicksort by Vladimir Yaroslavskiy, Jon Bentley, and Joshua Bloch. This algorithm offers O(n log(n)) performance on many data sets that cause other quicksorts to degrade to quadratic performance, and is typically faster than traditional (one-pivot) Quicksort implementations.

Parameters:

`a - the array to be sorted`

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Python's `.sort()` function uses a hybrid of merge sort and insertion sort, called **Timsort**

Timsort

11 languages

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From Wikipedia, the free encyclopedia

Timsort is a hybrid, stable sorting algorithm, derived from merge sort and insertion sort, designed to perform well on many kinds of real-world data. It was implemented by Tim Peters in 2002 for use in the Python programming language. The algorithm finds subsequences of the data that are already ordered (runs) and uses them to sort the remainder more efficiently. This is done by merging runs until certain criteria are fulfilled. Timsort has been Python's standard sorting algorithm since version 2.3. It is also used to sort arrays of non-primitive type in Java SE 7,[4] on the Android platform,[5] in GNU Octave,[6] on V8,[7] Swift,[8] and Rust.[9]

It uses techniques from Peter McIlroy's 1993 paper "Optimistic Sorting and Information Theoretic Complexity".[10]

Timsort

Class	Sorting algorithm
Data structure	Array
Worst-case performance	$O(n \log n)$[1][2]
Best-case performance	$O(n)$[3]
Average performance	$O(n \log n)$
Worst-case space complexity	$O(n)$

Let's go back to when we were writing our own Linked List and Node class

For example, this Linked List could only hold Strings

```
public class Node {

    private String name;
    private Node next;

    public Node(String c) {
        this.name = c;
        this.next = null
    }
   …
}
```

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   …
}
```

If we wanted to have Linked List hold Doubles, we would need to modify parts of the Node and LinkedList class

```
public class Node {

    private double value;
    private Node next;

    public Node(double c) {
        this.value = c;
        this.next = null
    }
   …
}
```

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It would be nice if we could allow our Linked List to hold **any type of data** without needing to modify the source code of our classes→ We can achieve this using **Java generics**

We can **embed** a class within another class (although I don't recommend doing this unless the class is very small and/or the classes are strongly related to each other)

```
public class GenericLinkedList {


    public class Node<E>{

        E data;

        Node<E> next;

        public Node(E data){
            this.data = data;
            this.next = null;
        }

        public E getData() {
            return this.data;
        }

        public Node getNext() {
            return this.next;
        }

    }


    private Node head;
    private int size;

    public GenericLinkedList() {
        this.head = null;
        this.size = 0;
    }

    public <E> void add(E newData) {
```

The data can be *any object*

When we create a Node object, we will give it some data type

getData() will now return some generic object E

Start of Linked List class

`<E>` is used to indicate that this Node class will hold a **Generic object**. It can be *any* object

This is very helpful for cases when we might not know what data type we will be working with

`<T>` is also a value used to indicate a generic object