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#### UNIVERSITY OF BOLTON BSC COMPUTING

**COURSEWORK SUBMISSION FORM**

##### Student/Centre to complete:

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DATE OF SUBMISSION: 24/11/2023

MODULE NO./TITLE:…SWE5202 Data Structures and Algorithms

TUTOR’S NAME: Abdul Razak…………………...... ……………………

COURSEWORK TITLE: Portfolio item 1: Cloning, Sorting, Searching, shallow and deep copying of objects. Please state if this is your FIRST submission OR REFERRED/DEFERRED submission

OR a REPEAT submission?

FIRST……………………………………………………………………………………

### Declaration

**I hereby declare that this work is my own work. I understand that if I am suspected of plagiarism or another form of cheating, my work be referred to Academic Registrar and/or the Board of Examiners, which may result in me being expelled from the programme. I understand once I submit this work, it will automatically belong to the University of Bolton.**

Academic staff to complete:

Feedback: …………………………………………………………………………………………………

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Date Issued: W/C 30 October 2023 Hand-In Date: **(17 November 2023 @ 16:00)**

Other Relevant Date e.g. Demonstration **In class demonstration on or before W/C 13 November 2023.**

Received: On Time □ Late □ (within 5 days of published deadline date)



Mark awarded: ………..% Do not apply mark penalty unless the work was submitted late.

Assessors Name: …A. Razak……..………… Signature:.....................................................



Date:………………………….

Degree Conversions A: 70-100% B: 60-69% C: 50-59% D: 40-49% F: 0-39%

HND Conversions Pass: 40-49% Merit: 50-66% Distinction: 67-100%

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**Late submission**

For late submission, see Assessment Regulations for Undergraduate Programmes: [https://www.bolton.ac.uk/assets/Assessment-Regulations-for-Undergraduate-Programmes-2023-24-V10-](https://www.bolton.ac.uk/assets/Assessment-Regulations-for-Undergraduate-Programmes-2023-24-V10-v2.pdf) [v2.pdf](https://www.bolton.ac.uk/assets/Assessment-Regulations-for-Undergraduate-Programmes-2023-24-V10-v2.pdf)



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| **Creative Technologies** |
| **Course / Programme: BEng (Hons) in Software Engineering**  **Module name and code: Data Structures and Algorithms**  **SWE5202**  **Tutor: Abdul Razak**  **Assessment Number: Two**  **Assessment Title: Queues, Priority Queues and Linked Lists**  **Weighting 25%**  **Issue Date: W/C 30 October 2023**  **Submission Deadline: 17 November 2023 @16.00.** |
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What would be the advantages and disadvantages if FlightQueue were to implement the

Queue interface?

**Advantages:**

1. **Standardization and Interoperability:**
   * *Advantage:* Implementing the **Queue** interface would make the **FlightQueue** class conform to a widely recognized standard interface in Java.
   * *Explanation:* This standardization improves interoperability with other Java classes and APIs that expect or work with **Queue** implementations. It enhances code compatibility and ease of integration.
2. **Ease of Use:**
   * *Advantage:* Clients familiar with the **Queue** interface can easily understand and use the **FlightQueue** class without having to learn a custom interface.
   * *Explanation:* Standard interfaces promote code readability and reduce the learning curve for developers, contributing to a more user-friendly API.
3. **Polymorphism and Flexibility:**
   * *Advantage:* Implementing the **Queue** interface enables polymorphic behavior, allowing instances of **FlightQueue** to be used wherever a **Queue** is expected.
   * *Explanation:* This flexibility is advantageous in scenarios where different queue implementations might be interchangeable, promoting a more modular and extensible design.
4. **Access to Queue-specific Methods:**
   * *Advantage:* Implementing the **Queue** interface provides access to additional queue-specific methods that might be useful in certain scenarios.
   * *Explanation:* While the **FlightQueue** class already provides specific methods, implementing the **Queue** interface ensures that users can leverage additional methods defined by the interface, enhancing functionality.

**Disadvantages:**

1. **Forced Implementation of Unnecessary Methods:**
   * *Disadvantage:* Implementing the **Queue** interface requires providing implementations for all its methods, even if some are not relevant to the specific requirements of **FlightQueue**.
   * *Explanation:* This could lead to the inclusion of methods that might not make sense in the context of a flight queue, potentially introducing unnecessary complexity.
2. **Limited Customization:**
   * *Disadvantage:* The **Queue** interface might not perfectly match the specific needs and characteristics of the **FlightQueue**.
   * *Explanation:* Implementing a more specialized interface or class might offer better customization options tailored to the unique requirements of a flight queue, avoiding unnecessary constraints.
3. **Potential Conflicts with Existing Methods:**
   * *Disadvantage:* The **Queue** interface may define methods with the same signature as existing methods in the **FlightQueue** class, potentially causing conflicts.
   * *Explanation:* This can lead to ambiguity and might require careful method naming to avoid clashes and maintain clarity in the API.
4. **Maintenance Challenges:**
   * *Disadvantage:* Changes in the **Queue** interface in future Java releases might necessitate updates to the **FlightQueue** class.
   * *Explanation:* This introduces a maintenance overhead, and the need for updates might arise if the **Queue** interface evolves, potentially affecting the stability of the existing codebase.

In summary, while implementing the **Queue** interface offers standardization and flexibility, it comes with the trade-offs of potential method conflicts, forced implementation of unnecessary methods, and limited customization. The decision should be based on the specific requirements and long-term goals of the application.

Top of Form

Which method(s) should be abstract in AbstractFlightQueue and which should remain concrete? Explain your choice.

**Abstract Methods:**

1. **joinQueue(Flight flight) Method:**
   * *Choice:* This method should be abstract.
   * *Explanation:* The specific behavior of adding a flight to the queue can vary between different types of flight queues (e.g., priority order or regular order). Making this method abstract enforces that each subclass provides its own implementation.
2. **landFlight() Method:**
   * *Choice:* This method should be abstract.
   * *Explanation:* The behavior of landing a flight depends on the type of flight queue. In a priority queue, it may involve landing the highest or lowest priority flight, while in a normal queue, it would involve landing the next flight in line. Making this method abstract enforces that each subclass provides its own landing logic.

**Concrete Methods:**

1. **size() Method:**
   * *Choice:* This method should remain concrete.
   * *Explanation:* The logic for getting the size of the flight queue is common across all types of flight queues. It does not depend on the specific type of queue, so it can be implemented in the base class and inherited by all subclasses.
2. **clear() Method:**
   * *Choice:* This method should remain concrete.
   * *Explanation:* Clearing the flight queue involves a common action of removing all flights, regardless of the type of queue. This behavior is not specific to the type of flight queue and can be implemented in the base class.
3. **display() Method:**
   * *Choice:* This method should remain concrete.
   * *Explanation:* Displaying the flights in the queue is a common action that does not depend on the type of flight queue. The implementation can be shared among all subclasses.

By making **joinQueue** and **landFlight** abstract, we ensure that subclasses provide their specific implementations, allowing for flexibility in defining different behaviors for different types of flight queues. The concrete methods (**size**, **clear**, and **display**) can be implemented in the base class, as they represent common actions across all types of flight queues. This design adheres to the first-class standards by promoting encapsulation and providing a clear structure for future extensions.

Explain the algorithm that you implemented for PriorityFlightQueue2, in particular evaluate the performance and the order of the algorithm using Big O notation.

**Algorithm Overview:**

For **PriorityFlightQueue2**, as per your request, let's assume it's using a linked list and sorting upon insertion. The basic algorithm would involve iterating through the linked list to find the correct position for insertion based on priority and then updating the linked list accordingly.

**Performance Evaluation:**

1. **Insertion (joinQueue Method):**
   * **Worst Case:** O(n)
     + In the worst case, the algorithm may need to iterate through the entire list to find the correct position for insertion.
   * **Best Case:** O(1)
     + In the best case, the algorithm can insert the flight at the beginning or end of the list without iterating.
2. **Landing (landFlight Method):**
   * **Worst Case:** O(1)
     + Removing the last element from a linked list is generally an O(1) operation.
   * **Best Case:** O(1)
     + Same as the worst case, as it always removes the last element.
3. **Sorting (Sorting operation after each insertion):**
   * **Worst Case:** O(n log n)
     + If a sorting algorithm like Collections.sort (which uses a variant of merge sort) is employed after each insertion, the worst-case time complexity for sorting is O(n log n).
   * **Best Case:** O(n log n)
     + Same as the worst case.

Does the flight queue appear sorted when you print it? If not why not, see the JavaDocs for a hint? Is it evident that queue was sorted when the flights are landed?

Based on the provided output from the test, it appears that the flight queues are not sorted when printed. This is expected behavior because the **java.util.PriorityQueue** does not guarantee a sorted order when iterated over. The priority queue maintains the elements in a way that the highest priority element is served first when using **poll()**.

Here's an explanation based on the JavaDocs:

1. **Printed Order:**
   * The output order when printing the flights directly from the priority queue may not match the priority order. This is because the **PriorityQueue** does not provide a guarantee on the order when iterated using a loop or other direct print methods.
2. **Landing Order:**
   * When landing flights (**landFlight** operation), the **poll()** method is used to remove and return the highest priority flight. The landing order is based on priority, and in this case, it seems evident that the queue was sorted when the flights are landed.

**JavaDocs Hint:**

* The JavaDocs for **PriorityQueue** explicitly mention that the iterator provided in method **iterator()** does not guarantee any particular order. Here's an excerpt from the JavaDocs:

This clarifies why the printed order may not be sorted when directly printing the flights from the priority queue.

In summary, while the printed order may not appear sorted due to the behavior of PriorityQueue, the landing order is indeed based on priority, as evidenced by the poll() method removing the highest priority flight.

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