Task 3: Queue Sorting with Limited Space

You have a queue of integers that you need to sort. You can only use additional space equivalent to one stack. Describe the steps you would take to sort the elements in the queue.

To sort the elements in the queue using only one additional stack, you can follow these steps:

1. Enqueue all elements from the queue to the stack: Pop elements from the front of the queue and push them onto the stack until the queue is empty.

2. Sort the stack elements: Now, the stack contains all elements from the original queue. Sort the elements in the stack using any sorting algorithm that can be implemented with only one stack, such as merge sort or insertion sort.

3. Enqueue sorted elements back to the queue: Once the stack is sorted, pop elements from the stack and enqueue them back to the queue.

Here's a more detailed explanation of each step:

1. Enqueue all elements from the queue to the stack:

- Pop elements from the front of the queue and push them onto the stack until the queue is empty. This process effectively reverses the order of elements, as elements are popped from the front of the queue and pushed onto the top of the stack.

2. Sort the stack elements:

- Now that all elements are in the stack, you can sort them using a sorting algorithm that can be implemented with only one stack. One option is to use merge sort:

- Divide the stack into two halves.

- Recursively sort each half of the stack.

- Merge the two sorted halves back together, maintaining the sorted order.

- Repeat until the entire stack is sorted.

- Another option is to use insertion sort:

- Pop elements from the stack one by one.

- Insert each popped element into its correct position in another temporary stack.

- Once all elements are inserted into the temporary stack, pop them back into the original stack, which will now contain elements sorted in ascending order.

3. Enqueue sorted elements back to the queue:

- Once the stack is sorted, pop elements from the stack and enqueue them back to the queue. Since elements were sorted in ascending order, they will be enqueued in the correct order in the queue.

After these steps, the queue will contain elements sorted in ascending order.