Divide and Conquer + Circular Dynamic Arrays Lab

Solve the following recurrence relations using the master theorem:

1. $T(n) = 2\,T(n/2) + n^2$ log2 2 < 2 so O(n^2)
2. $T(n) = 9\,T(n/3) + n$ Log3 9 > 1 so O(n^2)
3. $T(n) = 4\,T(n/4) + n$ Log4 4 = 1 so O(n lg n)
4. $T(n) = 2\,T(n/2) + 1$ Log2 2 > 0 so O(n)

Show the operation of the majority element problem on the following data:

5. 1 2 3 2 2 2 1 1 3 3 2 2 2 2

How would the algorithm perform differently if there was one less 2 at the end of the data:

6. 1 2 3 2 2 2 1 1 3 3 2 2 2

How would the algorithm perform differently if the last two 2s at the end of the data are removed:

7. 1 2 3 2 2 2 1 1 3 3 2 2

5. (1, 2) (3, 2) (2, 2) (1, 1) (3, 3) (2, 2) (2, 2)
   (2, 1) (3, 2) (2)
   return 2;

6. (1, 2) (3, 2) (2, 2) (1, 1) (3, 3) (2, 2) (2)
   (2, 1) (3, 2) (2)
   return 2;

7. (1, 2) (3, 2) (2, 2) (1, 1) (3, 3) (2, 2)
   (2, 1) (3, 2)
   return void;

Circular Dynamic Arrays

We can support the four operations: AddFront(x), AddEnd(x), RemoveFront(), and RemoveEnd() in constant amortized time by treating the storage as circular. Note that this gives rise to two perspectives of the array. The first perspective is the physical storage, with the data potentially "wrapped-around". The user perspective, however, can be one where the array always stores items in the locations with indices 0…N-1

With this in mind, start with a circular dynamic array in the state shown below:

			front			back	
			8	7	9	3	

8. What would the state of the physical storage be if we perform an AddFront(5), RemoveEnd(), and AddFront(4) operations. From the user's perspective, what would the item at index 2 be?

	front				back		
	4	5	8	7	9		

The item at index 2 would be 8

9. Continuing from the previous problem, what would the state of the physical storage be after a RemoveEnd(), an AddFront(10), AddEnd(1), and AddFront(2) operations. From the user's perspective, what would the item at index 0, what about the item at index 5?

					back		front
10	4	5	8	7	1		2

Index 0 is 2

Index 5 is 7