

CSCE 221

Problem Set 21

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I.

A.

1) *push(x)*: maintain a pointer data member to "front" of deque. As with a doubly linked list, x child is head, head parent is x, point head to x.

2) *pop()*: maintain a pointer data member to "front" of deque. As with a doubly linked list, point a cursor to front, point head to child, head parent is null, cursor child null, return cursor.

3) *inject(x)*: maintain a pointer data member to "rear" of deque. As with a doubly linked list, x parent is rear, rear child is x, point tail to x.

4) *eject()*: maintain a pointer data member to "rear" of deque. As with a doubly linked list, point a cursor to rear, point tail to parent, tail child is null, cursor parent null, return cursor.

5) *findMin()*: since the deque is in heap order, find min is just dereferencing the pointer that has been stored that points to the end of the deque with the minimum value, which requires 1 operation.

B.

As described above, the total number of operations to execute the functions(including memory allocation) are

$$push(x) : 4$$

$$pop() : 5$$

$$inject(x) : 4$$

As one can see, these operations do not rely on the size of the deque, so our time complexity becomes

$$4O(1) + 5O(1) + 4O(1) \rightarrow \boxed{O(1)}$$

C.

In the worst possible case, we use the implementation described above but every node in the deque has a member function that recursively calls all of the other node functions in the deque, and two deques to store the results of the function and the desired permutation. This function bogosorts the list until the list is the exact symmetric permutation and every node must have to the same list, call the opposite of whichever operation was desired (push becomes inject etc.), call bogosort again for every node until the original list is found and every node agrees.

Call this function X with runtime $O(X)$ and probability of occurrence $\frac{1}{O(X)}$ then, since operations are $O(1)$ for $O(X)$ operations, amortized time remains $O(1)$.

$$\int_0^{10} 10dx = 10 \int_0^{10} dx = 10x_0^{10} = 10(10 - 0) = 10 * 10$$