

For both Stacks and Queue. `__str__` have a worst case performance of  $O(n)$ , since the program has to loop through the structures to get the string representation.

For both Stacks and Queue `__len__` have a worst case performance of  $O(1)$ , since the methods just return a parameter.

For Array\_Deque, push runs at  $O(n)$  since the element gets added to the front of the list, while for the Linked\_List\_Deque push runs at  $O(1)$  since it takes the same time to insert a node at index 0 in all cases.

Pop is an  $O(n)$  method for the Array\_Deque since we are removing the first element and then the code manually shifts over each element to the left one index, resulting in  $O(n)$ . Pop for Linked\_List\_Deque runs at  $O(1)$  since removing the first element and returning that element always runs at the same runtime.

Enqueue is an  $O(n)$  method for Array\_deque since at worst case, the array has to be grown. Meanwhile enqueue for Linked\_list\_deque can be done in  $O(1)$  time since the push\_back method for Linked\_list\_deque is in constant time.

Dequeue is an  $O(n)$  method for Array\_deque since for arrays, each element has to be moved over for my array\_deque implementation. Meanwhile dequeue for Linked\_list\_deque can be done in  $O(1)$  time since the pop\_front method for Linked\_list\_deque is in constant time.

Peek for both representations of both Stack and Queue can be done in  $O(1)$ , since it is a matter of accessing the element at index 0, which can be done in constant time.

Personally, I think the idea to not raise exceptions is a mistake, since users may not realize that they're using the structure wrong if there is no error. This limits functionality because somebody could keep trying to remove elements, while there are none left, causing other errors in the code and confusion over the cause.

My test cases were to create a new stack and queue, and then just adding a few elements and then calling pop more times than there were elements, printing, and seeing the value of the stack/queue, pop, and peek at each step. This checks to see if all the methods work by testing the functionality and showing what the results are for the programmer to see, therefore making up a good set of test cases.