

Homework 2

COSC-160

Due: F 9/17 @ 11:59 PM EST

You must upload a PDF document to Canvas. Feel free to use pencil and paper to do this homework. If you do, please do not submit a PDF document containing high-resolution digital photographs. Use a PDF scanner such as GeniusScan to produce black-and-white scans for a PDF document.

1. Write the algorithm `enqueue` that inserts an item at the back of a queue. Use an array as the queue's internal representation. Derive $f(n)$ and $O(g(n))$.
2. Write the algorithm `dequeue` that removes the item at the front of a queue. Use an array as the queue's internal representation. Derive $f(n)$ and $O(g(n))$.
3. Write the iterative algorithm `remove` that removes the i th item from an unsorted list. Use an array as the list's internal representation. Assume that the i th element in the list is stored in the i th component of the array. What is the worst case? Derive $f(n)$ and $O(g(n))$.
4. Write the iterative algorithm `remove` that removes a specified object from a list. Use an array as the list's internal representation. What is the worst case? Derive $f(n)$ and $O(g(n))$.

5. Consider BUBBLE-SORT (Cormen et al., 2009, p. 40):

```
1: procedure BUBBLE-SORT( $A$ )
2:   for  $i = 1$  to  $A.length - 1$  do
3:     for  $j = A.length$  downto  $i + 1$  do
4:       if  $A[j] < A[j - 1]$  then
5:         exchange  $A[j]$  with  $A[j - 1]$ 
6:       end if
7:     end for
8:   end for
9: end procedure
```

- (a) What is the best case? Explain why.
- (b) What is the worst case? Explain why.
- (c) Derive expressions for the number of primitive operations for each step of BUBBLE-SORT.
- (d) Derive $f(n)$ for the worst case.
- (e) Derive $\Theta(g(n))$, $O(g(n))$, and $\Omega(g(n))$. State the constants for these running times.

- (f) Compute $f(n)$, $c'g(n)$, and $c''g(n)$ for $1 \leq n \leq 5$.
- (g) Plot $f(n)$, $c'g(n)$, and $c''g(n)$.

References

T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein. *Introduction to Algorithms*. MIT Press, Cambridge, MA, 3rd edition, 2009.