

CSIEB0100 Data Structures, Fall 2015
Midterm Exam

ID: _____ Dept: _____ Name: _____

1. (5%) Given an algorithm that solves a problem in three phases. The first phase takes $O(10n^2)$ to input the data of size n . The second phase takes $O(n^2 \log n)$ to process the data. The third phase takes $O(n)$ to output the data.
 - (a) What is the complexity of the algorithm?
 - (b) If the data size is 10, which phase is most likely to take the longest time to execute?

2. (10%) For each of the complexity expression below, determine its overall complexity. For example, given expression $2n + 3n$, the overall complexity should be $O(n)$.
 - (a) $2n^3 + 5n^2 + 3n$
 - (b) $n! + 3^n + 2n^3$
 - (c) $3n^2 + n \log n$
 - (d) $n^{1.001} + n \log n$
 - (e) $2n^3 + 5n^2 \log n + 3n$

3. (15%) Given an array of integers $A[0, \dots, n-1]$, write C++ functions to compute the postfix sum of A in the following ways.
- (a) Output the postfix sum to a new array B . In other words, $B[n-1]=A[n-1]$, $B[n-2]=A[n-1]+A[n-2]$, $B[n-3]=A[n-1]+A[n-2]+A[n-3]$, etc.
- (b) Save the postfix sum in A itself.

4. **(20%)** An *i-stack* is similar to an ordinary stack, except that it allows you to delete the *i*th element from top instead of just the top element (*i*=0 means the top element).
- (a) Design an ADT to represent an *i-stack*.
 - (b) Write a C++ class to implement the *i-stack* ADT.

5. (20%) A *reversible-queue* is similar to an ordinary queue, except that it supports a function to reverse the queue, i.e. new elements are added at the front end and deleted at the rear end. The reverse function can be called repeatedly to switch the queue back and forth.
- (a) Design an ADT to represent a *reversible-queue*.
 - (b) Write a C++ class to implement the *reversible-queue* ADT.

6. **(15%)** Write a function to check if a string is a palindrome. A palindrome is a string that reads the same backward or forward irrespective of case, white space, and punctuation (note that this is more general than the assignment problem). For examples, “radar”, “Don't nod”, and “Was it Eliot’s toilet I saw?” are all legal palindromes. Write the main program to test your function.

7. **(20%)** Let the difference between string s1 and s2 is defined as the resulting string of removing all words in s1 that appears in s2. For example, if s1="To see is to believe" and s2="What you see is what you get", then the difference between s1 and s2 is "To to believe". Write a function to compute the difference between two strings. Write a main program to test your function.