ITP 20001-01 Data Structures, Spring 2023

Midterm Exam – Part II. Written Test

Your name and student number: _____

- You have **70 minutes** to answer to **6 problems** (100 points).
- Check you have total **7 pages** including this cover and last two blank pages.
- Write an answer **only in the given box**. Things outside the box will not be counted.
- Write answers **clearly and legibly**. No points for ambiguous and illegible writings.
- Read the following quote from *Handong CSEE Standard* and declare your agreement below.

> Examination
>
> 1. Examination is an educational act necessary for evaluation of the students' achievement and for encouraging the students to absorb the material in the process of preparation.
> 2. Student should do their best to prepare for exams in order to improve her/his own knowledge and skill and should fully engage in the test during examination hour.
> 3. Accessing or providing unauthorized information, including other students' answer sheets, is regarded as cheating. The use of electronic devices, including cell phones and computers, without permission is strictly prohibited.
> 4. Entering or leaving the classroom during the examination before the finish time without permission is regarded as cheating.

I agree to uphold Handong Honor Code and Handong CSEE Standard in taking this exam.

Signature: _____

1. Find all syntax errors and inappropriate C++ code elements in `stringlist.cpp`, and suggest how to fix them (18 points).

2. Show that $(n+1)^5$ is $O(n^5)$ (16 points).

3. Given an n-element unsorted array A of n integers and an integer k, describe an algorithm for re-arranging the element in A such that all elements less than k come before any elements greater than or equal to k.

Find an algorithm for this problem, and analyze its time complexity (20 points)

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4. Write a body of function `void llist_reverse (llist * l)` in `llist.c` that reverses the order of elements while not creating any new `llist_node` objects (15 points)

5. Linked list and array list are two different list implementations sharing the same interface. Discuss for which situations using array list is better than using linked list. (15 points).

6. Write an algorithm that receives a set of distinct numbers and then prints out all possible sequences (i.e., permutations) of them -- this algorithm must use a stack and must not use recursive function calls. For example, given input {1, 2, 3}, the algorithm must print out "`123 132 213 231 312 321`". (16 points)

   * Hint. Use data structure `list` with the following operations (for a list object `l`).

`list()`	return an empty list
`length(l)` for list `l`	return the length of list `l`
`add(l, e)` for list `l` and element `e`	return a list containing all elements of `l` in order, and then `e`
`del(l, e)` for list `l` and element `e`	return a list containing all elements of `l` in order, except `e`
`get(l, i)` for list `l` and index `i`	return the element at index `i`
`comp(l1, l2)` for lists `l1` and `l2`	return a list containing all elements of `l1`, that is not contained in `l2`

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