

Institute for Advancing Intelligence (IAI), TCG-CREST  
Mid-Semestral Examination  
Ph.D Program Session: 2023–2024, Semester-I  
Subject: Introduction to Programming and Data Structures

Date: 06. 10. 2023

Full Marks: 40

Time : 3 Hours

Instructions:

- Try not to answer more than **Two** questions. If done maximum two will be considered. The maximum you can score is 40.
- Some of the questions require files. They can be downloaded from the digital version of the question paper kept in the *course webpage*.
- For submission, keep the names of the solution files as `roll_x.c`, where `roll` is your roll number and `x` is the problem number. Finally, upload them as a single zip file containing all necessary supporting files. Upload via usual submission link.
- Please keep your *roll number* and *problem number* in the header of each solution file.
- Assume inputs are correct to avoid unnecessary error handling. Language to be used: C.

1. Suppose you are given two square integer matrices of order  $n$  in two files `matrix_a.txt` and `matrix_b.txt`. You know that each row and column of the matrices contains only one non-zero element. In general, matrix multiplication requires  $o(n^3)$  integer multiplication and  $o(n^2)$  storage.

Your task is to store the matrices only in  $o(n)$  storage and multiply them with  $o(n^2)$  integer multiplication. Finally, display the result in the terminal. Show error message if the order of the matrices are different.

- *Input:* Two square matrices in the files `matrix_a.txt` and `matrix_b.txt`.
- *Output:* Display the result in the terminal.
- *Note:* Dynamic memory allocation is not necessary.
- *Restriction:* You can not take any storage more than  $o(n)$  for doing any purpose.

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2. Given a file `words.txt` of words at random order, write a C program to sort the words in the lexicographical order (dictionary order) and output the sorted words in the file `sorted_words.txt`.

- *Input:* a file `words.txt`. Each line is a string of maximum length 30.
- *Output:* a file `sorted_words.txt`, containing sorted words.
- *Restriction:* only `strcpy` function can be used from `<string.h>` library.

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3. Now, write a function that moves the last node to the front in a given Singly Linked List.

- *Input:* Give at least the following choices to the user
  - (a) add element to the linked list
  - (b) move node from the last to the front.
- *Output:* Display the list after each operation in the terminal.
- *Note:* In assignment 04, you were asked to implement some functions related to singly linked list. You can use that code.
- *Restrictions:* While moving a node, you can not change the value in the nodes.

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4. Write a C program that takes a text file `sentence.txt` that contains a single line of text and reverses the order of the words within it. Ensure the program operates under the assumption that the line comprises no more than 1000 characters. The space character serves as the delimiter between individual words.

- *Input:* The file `sentence.txt`
- *Output:* Display the modified sentence in the terminal.

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Introduction to Programming and Data Structures

Mid-Semestral Lab Test

PhD Coursework, Semester-I, 2023-24

Sample Inputs and Outputs:

Question 1:

Input: matrix_a.txt	Input: : matrix_b.txt	Output
4	4	4
0 2 0 0	0 0 3 0	3 0 0 0
0 0 0 3	0 0 0 1	0 0 4 0
1 0 0 0	0 2 0 0	0 0 0 6
0 0 4 0	4 0 0 0	0 8 0 0

Question 4:

Input	
I promise that I will definitely write a paper every year, either for a journal or a conference.	
Output	
conference. a or journal a for either year, every paper a write definitely will I that promise I	

Question 2: On next page

Input Part-I	Input Part-II	Output Part-I	Output Part-II
the and is of it in you that he was for on are with as ice his they be at one have this from or had by hot word but what some we can out other were all there when up use your how said an each she which do	their time if will way about many then them write would like so these her long make thing see him two has look more day could go come did my sound no most number who over know water than call first people may down side been now find any new	about all an and any are as at be been but by call can come could day did do down each find first for from go had has have he her him his hot how ice if in is it know like long look make many may more most my	new no now number of on one or other out over people said see she side so some sound than that the their them then there these they thing this time two up use was water way we were what when which who will with word would write you your