Indian Institute of Information Technology, Sri City, Chittoor

IIITS/S2023/Mid-1 Exam
Examination: Data Structures and Algorithms Duration: 1.5 hrs

Date: 18/04/2023
Max. Marks: 20

Instructions:

1. The exam is closed book and student(s) are not allowed to bring Text book(s)/ Photocopies/ Hand-written notes/ laptops.
2. Write the solutions clearly and legibly using pen (NOT pencil).
3. Marks are indicated in [ ].
4. Answer all the questions.
5. **All questions must be answered in the same order of their numbers (i.e. first Q1 must be answered, then Q2, then Q3, and so on.)**

Q1. (a) Solve the following recurrence relation $T(n)=\sqrt{2}T(n/2)+\sqrt{n}$ (when $n>1$) and $T(n)=1$ (when $n=1$) using the substitution method. **[3]**

(b) Solve the following recurrence relation $T(n) = 2T(n/2) + n$ (when $n>1$) and $T(n)=1$ (when $n=1$) using the recursion tree method. **[2]**

Q2. (a) Write the master theorem for solving recurrence. **[1.5]**

(b) Solve the following recurrence using master theorem. **[1]**

$$T(n) = 4T(n/2) + n^2/2$$

(c) Can the master theorem be applied to the recurrence $T(n) = \sqrt{n}\,T(n/5) + n^5$? Justify it. **[0.5]**

Q3. (a) Write the pseudocode for the following and analyze the worst case complexity in case of array:

i. Insertion at i^{th} position
ii. Deletion at end position

[2]

(b) Find the address of A[15][8] for the following matrix stored using row major order

i. Two dimensional array A[32][15] starting with index A[2][3], consists of 4 bytes of memory for each element.
ii. The base address is 250 **[1]**

Q4. (a) Write the pseudocode for inserting a node in a singly linked list and analyze the worst case complexity. Note that nodes should be inserted in the linked list in the ascending order. **[1.5]**

(b) Analyze the best case and worst case complexities of deleting a node from a singly linked list. **[1.5]**

Q5. Consider a circular linked list having three nodes - *p,q,* and *r*. The head stores the address of the first node (*p*) whose address is 100. The second and third nodes, *q* and *r*, are having addresses 200 and 300 respectively. Suppose you want to insert a node *n* (having address 50) at different places as follows: **i)** In the beginning (before p), **ii)** in the middle (after p and before q), **iii)** in the end (after r)

a. In case 1 above, what will be the updated value of head, n->next, and r->next? **[1]**
b. In case 2 above, what will be the updated value of p->next, and n->next? **[1]**
c. In case 3 above, what will be the updated value of head, r->next, and n->next? **[1]**

Note: Please note that there is no step marking for subquestions a,b, and c. If one value is wrong, no marks will be awarded for that subquestion.

Q6. Write a code and explain using the appropriate diagrams/example for doubly linked list (list of positive integers) with insert number before second even number in the list. Discuss the time complexity and justify your answer. **[3]**