SEAT NO. CT-22090

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

SECOND YEAR(Bachelor of Science in Computer Science & Information Technology)

FALL SEMESTER EXAMINATIONS 2023

Batch 2022

Time : 3 Hours

Dated : 27-JAN-24

Max Marks : 60

Data Structure Algorithms & Applications - CT-159

- Read the questions carefully.
- Attempt all questions in order they appear.
- You can make any logical assumption while solving a question.
- All questions carry equal marks.

Question 1: Explain the step-by-step process with the help of diagrams to perform Heap Sort on the given array {73, 6, 57, 88, 60, 42, 83, 72, 48, 85}. Additionally, discuss the efficiency of Heap Sort when compared to Bubble Sort in the given case.

[CLO-1: 10 Marks]

Question 2: Describe hashing in the context of data structures and explain its significance in achieving efficient data retrieval. Subsequently, discuss the distinct collision avoidance techniques used in hashing, providing a comprehensive explanation along with examples for each.

[CLO-1: 10 Marks]

Question 3: Given the following set of numbers: [21, 26, 30, 9, 4, 14, 28, 18, 15, 10, 2, 3,7], **illustrate** the AVL tree by inserting each number one by one in the given order. After each insertion, draw the resulting AVL tree and specify the balance factor at each node. Ensure that the tree remains balanced after each insertion. Explain the rotations performed, if any, and justify why they were necessary to maintain the AVL tree property. Finally, provide the final AVL tree after all the numbers have been inserted.

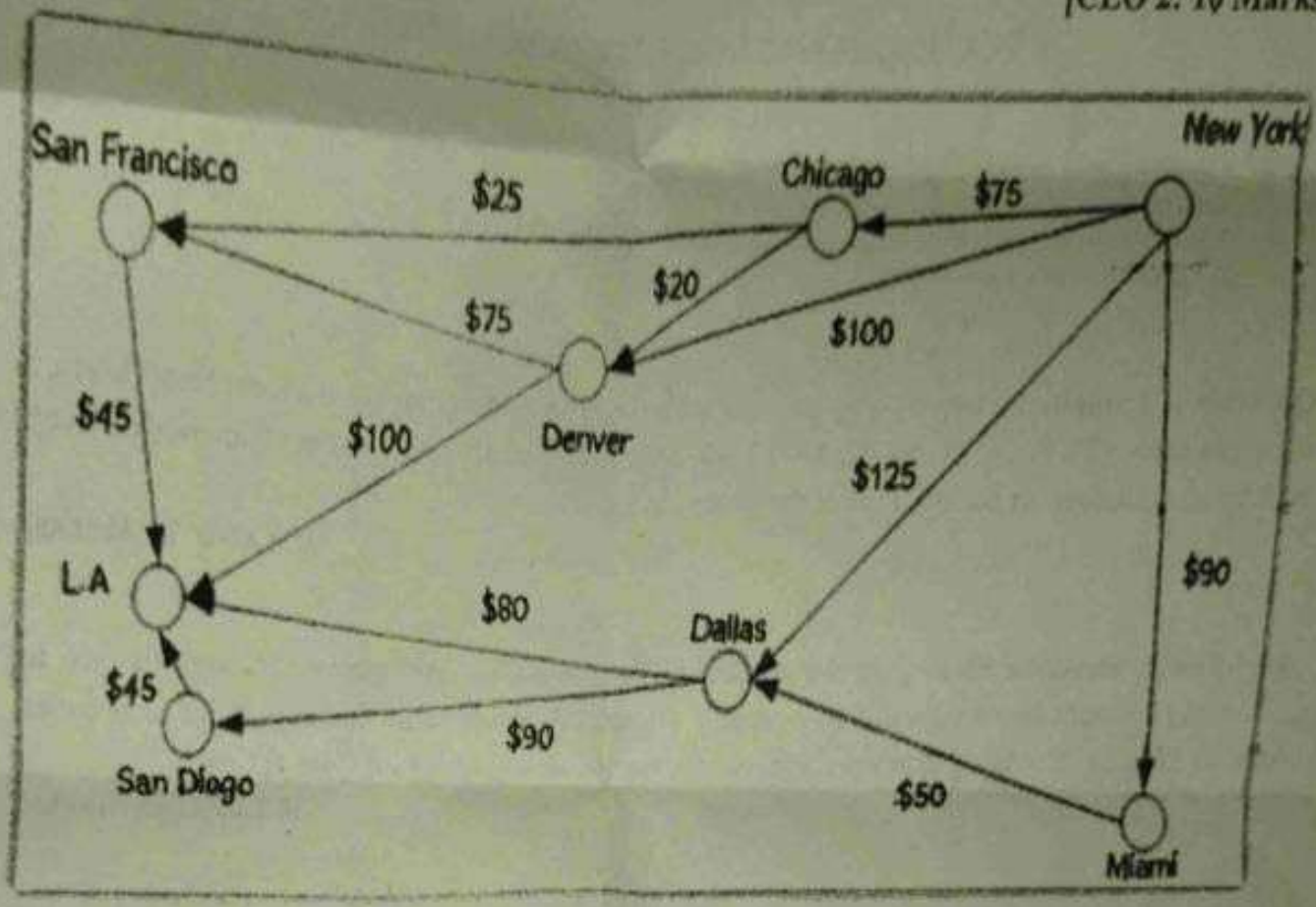
[CLO-2: 10 Marks]

Question 4: Consider a circular linked list L, with only a reference to the last node defined as the tail. **Develop** pseudocode (or C++ code) for a method named as **removeAfter()** that takes a linked-list node as an argument and removes the node following the passed argument. The method does nothing if the argument or the next field in the argument node is null.

[CLO 2: 10 Marks]

Question 5: Different flight options and fares between states of USA are presented in the graph given below. **Evaluate** the minimum-cost tours from New York to all other states.

[CLO 2: 10 Marks]



Question 6: An expression is considered correct if it contains an equal number of opening and closing brackets. While using a stack is a common approach for verification, there is an alternative method using a counter. **Develop** pseudocode (or C++ code) for both methods to check the correctness of an expression.

[CLO 2: 10 Marks]

Dr. Murk Marvi

SEAT NO. CT-005

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

SECOND YEAR(BACHELOR OF SCIENCE IN COMPUTER SCIENCE & INFORMATION TECHNOLOGY)
FALL SEMESTER EXAMINATIONS 2022
BATCH 2021

Time: 3 Hours **Dated:08-02-2023**
Max.Marks:60

Data Structure Algorithms & Applications - CT-159

- Read the questions carefully.
- Attempt all 10 questions.
- All questions carry equal marks.
- You can make appropriate assumptions if needed.

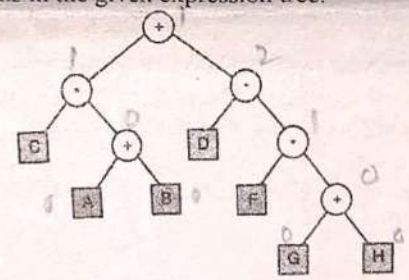
1. **Show** the output for the following algorithms. [CLO-1, Marks 6]

```
algorithm fun1 (x<integer>)
    if(x<5)
        return 3*x
    else
        return (2*fun1(x-5)+7)
    end if
end fun1

fun1(12)?
```

```
algorithm fun3(x<integer>, y<integer>)
    if(x>y)
        return -1
    else if (x equal y)
        return 1
    else
        return (x*fun3(x+1, y))
    end if
end fun3
fun3(4,7)
```

2. **Classify** if the following expression tree is perfectly balanced or not. Also, **show** the prefix, infix, and postfix expressions in the given expression tree. [CLO-1, Marks 6]



3. **Infer** the correct data structure for the following scenarios with proper justification. [CLO-1, Marks 6]

   i. Read the input one line at a time and then write the lines out in reverse order, so that the last input line is printed first, then the second last input line, and so on.

   ii. Read the input one line at a time. At any point after reading the first 42 lines, if some line is blank (i.e., a string of length 0) then output the line that occurred 42 lines prior to that one. For example, if Line 242 is blank, then your program should output line 200.

4. **Translate** the following data read from a keyboard into a binary max heap. **Illustrate** the delete/pop operation to the created heap. Also, **show** the repaired heap after deletion.
   23 7 92 6 12 14 40 44 20 21 [CLO-1, Marks 6]

P.T.O

5. **Explain** the following methods on the hash function $h(x) = 7 - (x \bmod 7)$ for the given input {4371, 1323, 6173, 4199, 4344, 9679, 1989}. Also, **compare** the results. [CLO-1, Marks 6]
   i. Separate Chaining
   ii. Linear Probing

6. It is a sweltering summer day, and a boy wants to buy some ice cream bars. At the store, there are N ice cream bars. You are given an array costs of size **N**, where **costs[i]** is the price of the ith ice cream bar in coins. The boy initially has **C coins** to spend, and he wants to buy as many ice cream bars as possible. **List** the steps of an algorithm/pseudo-code that takes **array of costs, its size N, and C as input** arguments and **return the maximum number of ice cream bars** the boy can buy with **C coins**. Also, **determine** its computational complexity. [CLO-2, Marks 6]

   Sample: Input: costs = [1,3,2,4,1], N=5, C = 7 - Output: 4

7. Sort the following numbers using QuickSort and Merge-Sort. **Analyze** the approaches to **determine** which one sorts the given data in the least number of steps.[CLO-2, Marks 6]

   1, 9, 5, 13, 3, 11, 7, 6, 18, 4

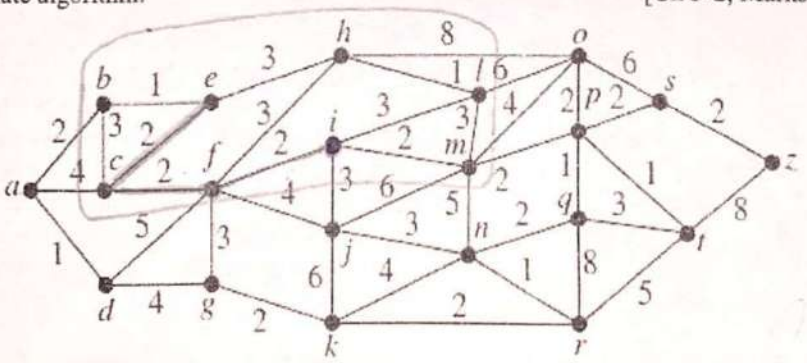
8. Given an integer array **nums of size N** and **an integer k**, **list** the steps of an algorithm/pseudo-code to determine the kth largest element in the array. Note that it is the kth largest element in the sorted order, not the kth distinct element. Also, **determine** its computational complexity. [CLO-2, Marks 6]

   Sample: Input: nums = [3,2,1,5,6,4], N=6, k = 2 - Output: 5

9. There are a total of numCourses you have to take, labeled from 0 to numCourses - 1. You are given an array prerequisites where prerequisites[i] = [ai, bi] indicates that you must take course bi first if you want to take course ai. For example, the pair [0, 1], indicates that to take course 0 you have to first take course 1. **Assume** that the given data is stored in the form of a directed Graph where each course would represent a vertex in the graph. **List** the steps of an *algorithm/pseudo-code that takes* **numCourses and prerequisites** *as input and returns the ordering of courses you should take to finish all courses. If there are many valid answers, return any of them. If it is impossible to finish all courses, return an empty array.*

   Sample: Input: numCourses = 4, prerequisites = [[1,0],[2,0],[3,1],[3,2]] - Output: [0,2,1,3] [CLO-2, Marks 6]

10. **Discover** the shortest path between **nodes c** and **m** of the following graph by using an appropriate algorithm. [CLO-2, Marks 6]



SEAT NO. CT-030

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

SECOND YEAR(BACHELOR OF SCIENCE IN COMPUTER SCIENCE & INFORMATION TECHNOLOGY)
FALL SEMESTER EXAMINATIONS 2021
BATCH 2020

Dated:17-02-2022
Max.Marks:60

Time: 3 Hours

Data Structure Algorithms & Applications - CT-157

Instructions: Attempt all questions. All questions carry equal marks.

1. (a) S and T are strings with length M and N respectively and are stored as array with one character per element. Write naive pattern matching algorithm, which finds the index of S in T (4)
   (b) Suppose S and T are two strings where S = 'JOHN PAUL JOHN' and T = 'A THING OF BEAUTY IS A JOY FOREVER' apply the following operations on the strings. (2)
   (a)Substring(S,4,8) (b)REPLACE(S, 'PAUL','DAVID') (4)
   (c) Write the algorithm to find the factorial of number. (2)
2. (a)Suppose an array SCORE is stored in memory, whose starting address is 200. Assume the word size for each element is 4. Then find address of SCORE[12,3]. (8)
   (b)Define the following with examples.
   1. Central Tree 2. Static variable. 3. Balanced binary tree. 4. Min heap.
3. (a)Consider the polynomial $P(x) = -10x^8y^5 + 7x^5y^5 - 2x^2y^3 + 4x^2y + 5xy$. Express it with the help of a circular header list. (5)
   (b) The following circular queue can store six elements. The current status of the queue is given by FRONT=2 and REAR=4 QUEUE= __,A,C,D,__,__,__. Maintain the queue by applying enqueue and dequeue procedures. Update front and rear accordingly. (5)
   a. Enqueue F
   b. Dequeue A,C
   c. Enqueue K,L,M
   d. Dequeue D,F.
   e. Enqueue R.
4. (a)What is the outcome of inorder, preorder, postorder traversal of the binary search tree in fig 3. (3)
   (b)Use depth first search and traverse the following tree. Write all the steps and procedure. (5)
   (c)Define inverted binary tree. Also determine the mirror of the tree. (2)
5. (a)Let DATA be the following unsorted 9 elements array: 56 89 32 54 67 12 44 86 34. Apply the merge sort algorithm stepwise to sort the elements in the array. (5)
   (b)Consider the algebraic expression ((A+B)/D)^((E-F)*G). Convert this notation stepwise to obtain postfix notation. Write the difference between infix notations and postfix notations. (5)
6. (a)Consider the graph in fig1. Determine the shortest path of the graph using Dijkstra's algorithm. Mention all steps. (6)
   (b)Define spanning tree. Determine the spanning tree of the graph in fig 2 using Kruskal's Algorithm. (4)

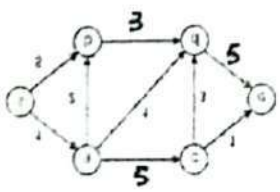


Fig 1.

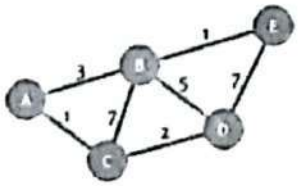


Fig 2.

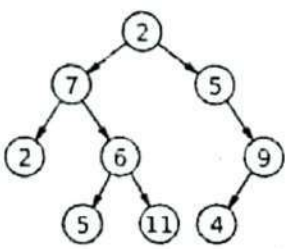


Fig. 3

SEAT NO. 153

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

SECOND YEAR FALL SEMESTER (ELECTRICAL ENGINEERING)
EXAMINATIONS 2019
BATCH 2018

Dated:03-02-2020

Time: 3 Hours **Max.Marks:60**

Data Structures and Algorithms - EE-264

Instructions:

1. **Attempt all Questions.**
2. **In case, if you find any missing information, assume by yourself and properly mention it.**
3. **All questions carry equal (10) Marks.**

Question 1: **[CLO1]**

Perform a detailed analysis of SELECTION SORT algorithm including general expression of running time, best case and worst case running times. Also, express the running time in θ-notation.

Pseudo Code:

```
SELECTION SORT
1.  For i = 1 to n:
2.      min_index = i
3.      For j = i+1 to n:
4.          If A[min_index] > a[j]:
5.              min_index = j
6.      Swap (A[i],A[min_index])
```

Question 2: **[CLO1]**

Perform the time complexity analysis under worst case for Merge Sort Algorithm (based on Divide and Conquer approach). Also, express your answer in relevant asymptotic notation.

Pseudo Code:

```
MERGESORT(A):
1.  n = length(A)
2.  if n < 2:
3.      return
4.  mid = n/2
5.  left = array of size (mid)
6.  right = array of size (n-mid)
7.  for i = 0 to mid-1:
8.      left[i] = A[i]
9.  for j = mid to n-1:
10.     right[j-mid] = A[j]
11. MERGESORT(left)
12. MERGESORT(right)
13. MERGE(left, right, A)
```

```
MERGE(L,R,A):
1.  nL = length(L)
2.  nR = length(R)
3.  i = j = k = 0
4.  while i < nL and j < nR:
5.      if L[i] < R[j]:
6.          A[k] = L[i]
7.          i = i + 1
8.      else:
9.          A[k] = R[j]
10.         j = j + 1
11.     k = k + 1
12. while i < nL:
13.     A[k] = L[i]
14.     i = i + 1
15.     k = k + 1
16. while j < nR:
17.     A[k] = R[j]
18.     j = j + 1
19.     k = k + 1
```

Question 3: **[CLO1]**

Explain the following Asymptotic Notations by considering an example,

1. O Notation
2. Ω Notation
3. Θ Notation

Question 4: **[CLO2]**

Demonstrate the mechanism of maintaining data in *stacks* and *queues*. What are their typical operations and policy? Write a python class named *Queue* that uses list structure to store the data inside of it. Also define all the functions, which Queue data structure typically offers, in *Queue* class.

Question 5: **[CLO2]**

You have been asked to develop a system which maintains data of employees in an organization. What would be your preference at implementation level (Traditional Procedural-Oriented programming -TPOP or Object-Oriented programming - OOP)? Take the fundamental components of OOP such as Class, use pseudo-code or C++ or Python and implement some of the following basic tasks related to this application.

a) Create an *Employee* class to store basic information of an employee like name, pay and job.
b) Write a method in *Employee* class to increase the salary of a person with desired percentage.
c) Create a sub-class of *Employee* named *Manager* which replaces the inherited method to increase the salary of a person by including an additional bonus of 10% added in the percentage input of a function.

Question 6: **[CLO2]**

Describe the following functions applied on Dynamic Sets:

1)SEARCH (S, k)
2) INSERT (S, x)
3) DELETE (S, x)
5) MAXIMUM (S)
6) PREDECESSOR (S, x)

SEAT NO. _____

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

FIRST YEAR SPRING SEMESTER (SOFTWARE ENGINEERING)
EXAMINATIONS 2019
BATCH 2018

Time: 3 Hours **Dated:02-08-2019**
Max.Marks:60

Data Structure Algorithms & Applications - CT-157

Instructions: Answer all questions
All questions carry equal marks
Use diagrammatic representation where necessary.

QUESTION#1 (C2)

a) **Discuss** Recursion along with two example algorithms. (4)
b) **Translate** the following prefix notation into infix notation: (2)
i. * - A B / D E ii. + / + A ^ B D – E F G
c) **Elaborate** the following circular array QUEUE with N=5 locations and initial condition

	A	C	D	

Front =2, Rear= 4. Perform the following steps and compute Rear and Front end (4)
i. F inserted ii. A and C are deleted iii. K,L and M inserted iv. D and F are deleted

QUESTION#2 (C2)

a) **Discuss** the algorithm of inserting into a sorted linked list. (3)
b) **Explain** the algorithm of finding the roots of quadratic equation. Also draw flow chart. (4)
c) A hospital maintains a patient file in which each record contains the following information (3)
Name, Admission Date, Social Security Number, Room, Bed Number, Doctor. **Defend:**
i. Which items can serve as a primary key?
ii. Which items can be group items?
iii. Which pair of items can serve as a primary key?

QUESTION#3 (C3)

a) **Demonstrate** the row major and column major representation of two dimensional 4x5 array in memory. (4)
b) Consider the following list of numbers (3)
34 56 78 22 11 90 86 42 65 77
Apply quick sort algorithm to find the final position of 77.
c) **Use** the header list to store the following polynomial: (3)
$p(x,y,z) = 3x^3yz - 5x^2y^3 + 8x^3y^2 - 4xyz^5$

QUESTION#4 (C3)

a) **Draw** the corresponding tree diagram of the following: (2)
01 Employee 02 Name 02 Number 02 Hours 03 Regular 03 Overtime 02 Rate

P.T.O

b) **Determine** whether a stack or a queue is the appropriate structure for the execution of the following situations. (2)

i. Program A calls subprogram B, which calls subprogram C and so on.
ii. Batch computer programs are submitted to the computer center.

c) **Compute** the postfix expression with the help of stack. (2)

3, 1, +, 2, ^, 7, 4, -, 2, *, +, 5, -

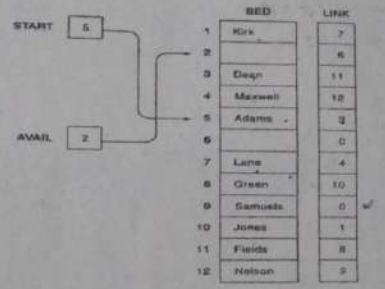
d) Consider the three dimensional array MAZE(2:8, -4:1, 6:10). **Compute** the location LOC(MAZE[5, -1, 8]. Base(MAZE)=200, w= 4 words per memory cells. Perform the necessary steps. (4)

QUESTION#5 (C2)

a) **Discuss** Memory Allocation: Garbage collection in linked list with the help of example. (3)

b) Consider the following linked list. **Explain** the pointer fields that are changed when (4)

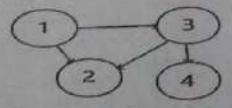
i) Walters is added to the list ii) Kirk is deleted from the list.



c) **Discuss** the average case and worst case complexity of linear search (3)

QUESTION#6 (C3)

a) **Apply** Warshall's Algorithm to find the transitive closure of the following directed acyclic graph. (4)



b) **Demonstrate** Control Structures in detail. (5)

c) The inorder traversal of the tree yields the following sequences of nodes: (3)

E A C K F H D B G

Draw the tree.

Q4: a) **Using** arithmetic modulo 15 find: i. 9+13 ii. 2-9 (3)

b) **Apply** Binary Search Algorithm to find the item 56: (3)

10,56,15,45,78,44,89,24,6,100 7

c) Consider the three dimensional array MAZE(2:8,-4:1,6:10). **Compute** the location LOC(MAZE[5,-1,8]. Base(MAZE)=200, w= 4 words per memory cells. Perform the necessary steps. (4)

628

Q5: a) **Discuss** the algorithm of finding the largest element in array also draw flow chart. (4)

b) **Compute** the polynomial from following linked list. The Head node of Poly1=1 and Head node of Poly2= 10 (2)

	COEEF	EXP	LINK
1	0	-1	5
2			
3	6	1	7
4	-3	2	10
5	3	5	8
6	2	8	9
7	-5	0	1
8	-4	3	3
9	7	5	4
10	0	-1	6

c) **Discuss** the quick sort algorithm along with the complexity. (4)

Q6: a) **Discuss** all the strategies towards linked list to store data. Also discuss the drawbacks of the strategies (4)

b) **Discuss** the data structures operations. (2)

c) Consider the student record given below. **Compute** the total elementary items of the structure. (2)

1 Student(20)
  2 Name
    3 Last
    3 First
    3 Middle
  2 Test(3)
  2 Final 160
  2Grade

d) **Give** example of a two way list with pointer FIRST, LAST and AVAIL. (2)

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NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

FIRST YEAR SPRING SEMESTER (SOFTWARE ENGINEERING)
EXAMINATIONS 2018
BATCH 2017

Time: 3 Hours **Dated:05-09-2018**
Max.Marks:60

Data Structure Algorithms & Applications - CT-157

Instructions: Answer all questions
All questions carry equal marks
Use diagrammatic representation where necessary.

Q1: a) Consider the following list of numbers (3)

34 56 78 22 11 90 86 42 65 77

Apply quick sort algorithm to find the final position of 77.

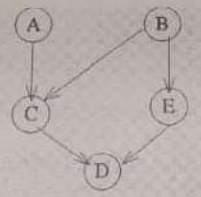
b) **Use** stack method to evaluate the following postfix expression: (2)

3, 1, +, 2, ^, 7, 4,-, 2,*, +, 5,-

c) **Solve** the Towers of Hanoi problem for n=4. There are 3 pegs in total labelled as A, B and C. Move all the disks from Peg A to Peg C. Write down the total number of moves. (3)

d) Consider the following n=5 sorted letters: A, B, C, D, E. If quick sort is apply on this, solve to find the total number of comparisons. (2)

Q2: a) Apply Warshall's Algorithm to find the transitive closure of the following directed acyclic graph. (4)



b) Consider the following String and **compute**: (3)

S= 'WE THE PEOPLE'

i. length of String ii. INDEX(S, '□THE□') iii. INSERT(S, 8. 'BEST□')

c) **Demonstrate** the algorithms of inserting and deleting elements in stack. (3)

Q3: a) **Discuss** the row major and column major representation of two dimensional 4x5 array in memory (4)

b) **Translate** the following expression into its corresponding tree diagram. (3)

$(7x+y)(5a-b)^3(c^2+d)$

c) Consider 25x4 matrix array SCORE. Suppose Base(SCORE)=200 and there are w=4 words per memory cells. **Compute** LOC(SCORE[21,2]). Using column major order. (3)

P.T.O

DS .

unsigned int array **primefactors[]. num** contains the number to be processed by any of the described functions and **ans** contains the result generated by any of the functions except for primeFactors(), for which the result is put into **primefactors[]** array.
The class should be named "NumberTheoretic" and all principles of abstraction and encapsulation must be incorporated in writing it. You are at freedom to define variables and functions other than those described here.

Question No. 4
The following is C++ implementation for the naive prime factorization algorithm:

```
int input,factor,factor_remainder, check=0;
cout<<"\n\nEnter a number to get its prime factors: ";
cin>>input;
cout<<"\n\nThe prime factors of "<<input<<" are:";

factor=2;                    // initialising factor with 2
                             // which could be the first factor

while(factor<=input)         // Termination Condition: factor is
{                            // increasing by 1 and input is reducing
                             // due to division

        if(isprime(factor)==1)      // which means factor is prime
        {
                factor_remainder=input%factor;

                // If factor is prime we have two cases:

                //1) That factor divides the input completely
                if(factor_remainder==0)
                {
                        input=input/factor;
                        cout<<factor<<",";
                }

                //2) The factor does not divide the input
                if(factor_remainder!=0)
                {
                        factor=factor+1;
                }

        }
        else                 // factor is composite
        {
                factor=factor+1;
        }
}
```

(15)

This program has an underlying problem: it is inefficient for some of the factors, as it tests "factor" for primality without consideration. Make this program a bit more considerate by modifying it in such a way that "factor" variable is only tested for primality when a new "factor" is selected. Also discuss how much performance gain would this modification bring to the program.

Question No. 5
Describe the Quick-Sort algorithm using an example and write a C++ function definition to implement it on a character array which starts at index i and ends at index j:

void quickSort(char array[], int i, int j);

(15)

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NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
SECOND YEAR SPRING SEMESTER (ELECTRICAL ENGINEERING)
EXAMINATION 2016
BATCH 2014-15 & PREVIOUS BATCHES

Time: 3 Hours

Dated: 28-04-2016
Max. Marks: 60

DATA STRUCTURE & ALGORITHMS- EE-264

Instructions:

1) **Attempt four (4) questions in all – all questions carry equal marks.**
2) **Answer the questions objectively in legible writing. Any missing information may be assumed and clearly mentioned.**
3) **Use pen to answer the questions and be precise and objective while writing codes. Careless syntax errors will be dealt with serious deduction in marks.**
4) **Your algorithms/programs should be valid for all possible sets of inputs.**

Question No. 1

a) What is "Algorithm Analysis" and why is it an important part of computer programming? Compare "Algorithm Analysis" with other desired characteristics of computer programming (compare with at-least five (05) other characteristics). **(07)**

b) Describe the three cases used to analyze algorithm performance, discussing significance of each method in detail. Demonstrate the application of ~~these~~ techniques on any algorithm of your choice and compute its asymptotic complexity with reference to θ(n) operator. **(08)**

any 3 of these

Question No. 2

Using the C++ vector class and algorithm library, write a program that allows user to enter 100 names in a string vector (the user should be allowed to stop entering names intermediately), sort them in ascending order (alphabetical order), and finally display them on screen. **(15)**
After writing the program, discuss the method/algorithm used for sorting the sequence of strings. How different is it from sorting a number sequence?

Question No. 3

Write a C++ class that contains the following number theoretic algorithms as functions: **(15)**

a) bool isPrime(unsigned int N); //checks whether N is prime or not
b) unsigned int gcd(unsigned int A, unsigned int B); //computes greatest //common divisor of A, and B integers
c) void primeFactors(unsigned int N, unsigned int factors[]); //computes prime factors of N and stores //them in factors[] array
d) bool isEven(unsigned int N); //checks if N is even or odd
e) bool isOdd(unsigned int N); //checks if N is odd

Apart from these functions, there may be some general input/output functions in the class. The class needs to have public and private sections, moreover it must contain private data comprising of two unsigned integers **num** and **ans** and an

$\theta(n) = n$

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

SECOND YEAR (SOFTWARE ENGINEERING)
FALL SEMESTER EXAMINATIONS 2020
BATCH 2019

Time: 3 Hours **Dated:11-2-21**
Max.Marks:60

Data Structure Algorithms & Applications CT-157

Instructions:

- ✓ Students are advised to attempt all questions in order
- ✓ All parts of a question must attempt altogether
- ✓ Q1,Q2 carries 15 marks (each) Q3,Q4,Q5 carries 10 marks(each)
- ✓ Q1 & Q2 belongs to CLO-1 and Q3,Q4,Q5 belongs to CLO-2

Q1.a Describe term "Rate of growth "of algorithm, ordered the following functions on the basis of their growth rate. [5]

i. n^2, 2n, n^3 , nlogn ii. 3n+100logn , 4n, 2^n iii. 2n ,2^{10},2^{logn}

Q1.b Write the upper bound of the following (make necessary assumptions and Show all calculations): [10]

i. T(n)={ 2T(n-1) , if n> 0; [2 marks]
1;otherwise

ii. Algo_Sol(a, b, c, x) [2 marks]

```
{
 v:=a*x;
 v:=v+b;
 v:=v*x;
 ans:=v+c;
 return ans; }
```

iii. [3 marks]

```
Void Func(int n)
{ If (n<=1) return;
    If(n>1) {
    For(i=1;i<=3,i++)
    Func(n-1);
    Print("*");}
}
```

iv. [3 marks]

```
function(int n) {
    int i, j, k , count =0;
    for(i=n/2; i<=n; i++)
        for(j=1; j + n/2<=n; j= j+1
            for(k=1; k<=n; k
                count++
```

Q2.a what do you understand by the term "divide & conquer "Algorithm, name two algorithms followed divide & conquer strategy. [4]

Dr. Murk Marvi

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY
SSCS, Midterm Examinations Fall 2022

Time: 90 minutes **Data Structure Algorithms and Applications (CT-159)-A** **Max Marks: 20**

Date: 07-12-2022

Note: Attempt all questions.

1. [CLO 1, Marks 3] In statistics and probability theory, the **median** is the value separating the higher half from the lower half of a data sample, a population, or a probability distribution. For a data set, it may be thought of as "the middle" value. For example, the median of set of integers 1, 3, 3, **6**, 7, 8, 9 is 6, and the median for the set of integers 1, 2, 3, **4, 5**, 6, 7, 8 is 4.5. ***Express*** an algorithm/pseudo code that determines the median from a set of integers entered by a user and stored in a dynamic array. The algorithm must ask a user to enter the size of array during run time, and then user should be asked to fill the array by entering the integers in any order. The algorithm in the end determines the median of the set of integers entered by the user.

Test case 1	
N – Size of the array	9
N number of integers to be stored in a dynamic array	213549867
Median is	5
Test case 2	
N – Size of the array	8
N number of integers to be stored in a dynamic array	31248675
Median is	4.5

2. [CLO 1, Marks 3] ***Indicate*** an algorithm/pseudo code to traverse a circular linked list and delete all nodes whose keys are negative.
3. [CLO 1, Marks 4] Given a string that consists of lower-case English letters and parentheses, ***estimate*** an algorithm/pseudo code through stack and queue to reverse the substrings in each pair of matching parentheses. The result should not contain any parentheses. For example, *(ng)(mpi)(ca)* should return *camping*. **Hint:** push characters on stack while reading the string expression. Use single queue for reversing the substrings. In the end, push the reversed string from queue back onto the stack.

4. [CLO 2, Marks 10] ***Illustrate*** the answers to the following short questions [2 Marks on each part].

i. ***Figure out*** the correct order of the following computational complexities from smallest to largest.

a. 2^n b. $n!$ C. n^5 d. 10,000 e. $nlog_2(n)$

ii. An algorithm runs a given input of size n. If n is 4096, the runtime is 512milliseconds. If n is 16,384, the runtime is 1024 milliseconds. ***Investigate*** the computational complexity of the algorithm.

iii. An array contains the elements shown below. Through the binary search algorithm, ***trace*** the steps followed to find 88. For each loop iteration, characterize the contents of first, last and mid. [8 13 17 26 44 56 88 97]

iv. ***Deduce*** the output of the following programs.

```
int main(){
 LinkedList List1, List2; // two linked list instance created.
 List1.insertFront(22);
 List1.insertTail(50);
 List2.insertFront(77);
 List2=List1;
 List2.display();
 return 0;
}
```

```
int main(){
 //Queue Q currently looks like this
 //__, London, Berlin, Rome, Paris, Athens, Mad
 Q.add('Athens'); //enqueue
 Q.remove();      //dequeue
 Q.remove();
 Q.add('Madrid');
 Q.display();
 return 0;
}
```

v. ***Analyze*** your algorithms in Questions 01 and 02 to determine their computational complexities by assuming both best and worst cases.

Q2.b Define “Hashing” & two advantages of hashing. Consider the Hash table (given below), use linear hashing Technique insert 277,421,426,206, also calculate no. of probes required to insert each key: [6]

0	Empty
1	911
2	Empty
3	374
4	Empty
5	Empty
6	1091

Q2.c Write down the difference between tree and graph DS, and their applications. Also State the characteristics of Proper and perfect binary trees [5]

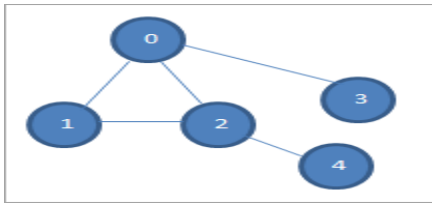
Q3.a write algorithm to check if a matrix is Toeplitz Matrix or not ,Calculate the Big-O of algorithm{Hint: A toeplitz Matrix is a matrix in which each descending diagonal from left to right is constant}. [5]
Hint: Here i,jelement of A denoted as A(i,j)

For instance, the following matrix is a Toeplitz matrix:

$$\begin{bmatrix} a & b & c & d & e \\ f & a & b & c & d \\ g & f & a & b & c \\ h & g & f & a & b \\ i & h & g & f & a \end{bmatrix}$$

Q3.b implement stack data structure by using queue ,also write algorithm to reverse the string by using queue data type. [5]

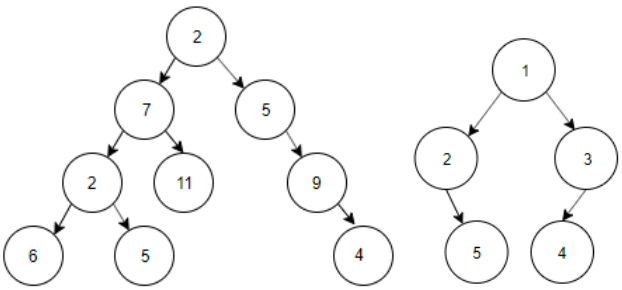
Q4.a Apply DFS to Traverse the following graph using stack data structure also give implementation.[8]



Q4.b from the graph (above), determine: [2]

i. Adjacency matrix of above graph.
ii. The matrix (above) is sparse or dense? justify your answer.

Q5.a Examine the following binary trees using the preorder traversal methods.[2]



Q5.b Apply bubble sort algorithm and show the step by step procedure to sort given data values: 23,11,37,28,15. Also give implementation. [8]

Best of Luck