

University of Ruhuna- Faculty of Technology
Bachelor of Information and Communication Technology Degree
Level 2 (Semester 1) Examination, March/April 2021

Course Unit: ICT2113- Data Structures and Algorithms

Time Allowed: 2 hours

Answer all four (04) questions.

(Theory Examination)

This question paper contains 06 pages.

Question 01

a) Define the following terms.

- I. Time complexity of an Algorithm.
- II. Spanning Tree.
- III. Trivial Graph.

b) Write time complexity of the following code segments in Big O notation.

- I.

```
int a = 0;
for (i = 0; i < N; i++) {
    for (j = N; j > i; j--) {
        a = a + i + j;
    }
}
```
- II.

```
for (int i = 0; i < n; i++)
    for (int j = i+1; j > i; j--)
        for (int k = n; k > j; k--)
            printf("*");
```

c) State three (3) differences between Bubble sort and Insertion sort algorithms.

d) List down three reasons for why we need data structures.

e) Write all the steps on how you search 80 in the following array using Binary Search method.

10 12 20 32 50 55 65 80 99

- f) Consider the following incomplete C code segment written to sort a set of integers using Insertion sort algorithm. Complete the code.

```
void main()
{
int arr[20],i,n,j,k;

printf("\nEnter the number of elements in the array: ");
scanf("%d",&n);

printf("\nEnter the elements of the array");

for(i < No of times to repeat) // Line A
{
    printf("\n arr[%d]= ",i);
    scanf("%d",&arr[i]);
}

int temp;

for(k < No of times to repeat) // Line B
{
    .....// Line C
    .....// Line D
}

while((temp < arr[j]) && (j >= 0))
{
    ..... // Line E
    .....// Line F
}
arr[j+1]=temp;

printf("\nThe sorted array is: \n");

for(i=0;i<n;i++)
    printf("%d\t",arr[i]);
}
```

Question 02

- a) Write the content of the stack after applying the following operations. Write all intermediate steps.

push(8), push(2), push(6), pop(), push(2), push(5), pop(), pop(), pop(), push(9), push(1), pop(), push(4), push(6), pop(), pop(), push(7), pop(), pop(), pop()

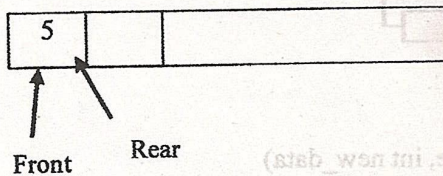
- b) Evaluate the following expression using a stack. State the content of the stack at each intermediate step.

5, 4, 6, +, *, 4, 3, 9, /, +, *

- c) Write four (4) operations that can be performed on a queue.

- d) Briefly describe two real world applications of queue.

- e) Consider following linear queue. Draw separate frames and output when each of the following operations are applied one after the other. (Assume that the queue is empty)



enqueue(8) -> enqueue(9) -> dequeue() -> enqueue(7) -> dequeue() -> front() -> dequeue()
-> dequeue() -> isEmpty() -> enqueue(9) -> enqueue(7) -> size() -> enqueue(3) -> enqueue(5) -> dequeue()

Your answer should be as follows:

Operation	Output	Frame			
enqueue(3)	-	<table border="1"> <tr> <td>5</td> <td>3</td> <td></td> </tr> </table>	5	3	
5	3				

Question 03

a)

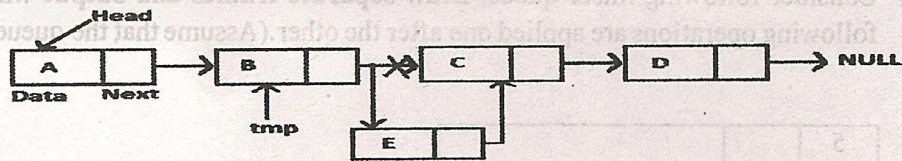
- I. Explain what a Link List is and the way it works.
- II. Write two drawbacks of Link Lists.
- III. What is the purpose of using a link between every two nodes in a link list?
- IV. Following diagram is used to create a double link list. Complete the C code to implement this assuming that integers are stored in the list.



Node

```
structNode {
.....
.....
};
```

- V. The function *insertAfter()* is written to insert a node after a given node. Complete the blank lines (A, B, C, and D) with suitable C statements.



```
void insertAfter(structNode* prev_node, int new_data)
{
if (.....)//Line A
{
printf("the given previous node cannot be NULL");
return;
}
structNode* new_node = ..... ;// Line B
..... ;// Line C
new_node->next = prev_node->next;
prev_node->next = ..... ;// Line D
}
```

b) Insert the following data into an initially empty binary search tree in the order they are given.

51, 76, 60, 23, 94, 12, 38

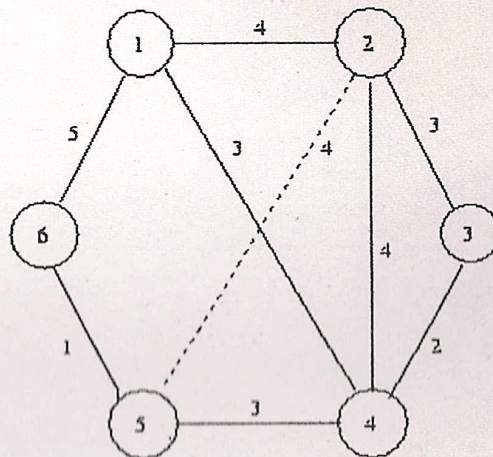
- I. Insert 100 to the above tree and draw the resultant tree.
- II. Print the data that you have inserted tree in the part (I) in the following orders.
 - i. Post Order
 - ii. Pre Order
- III. How many internal nodes are there in above tree?
- IV. What is the height of the node 23?

c) Represent the following expressions in binary trees.

- I. $A * B - (C + D) * (P / Q)$
- II. $A + (B * (C / D))$

Question 04

a) Consider the weighted graph given below,



- I. Write the adjacent matrix for the above weighted graph.
- II. Write the adjacency list for the above graph without considering weights.

End of the paper

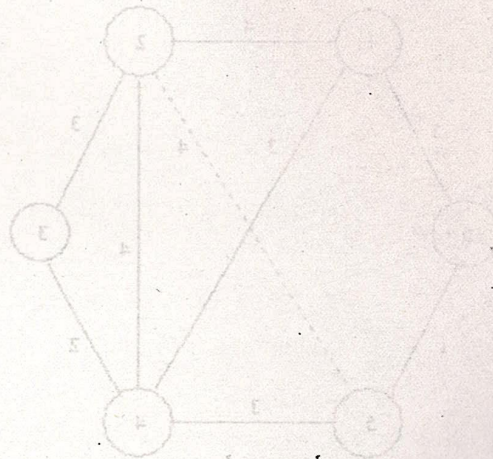
b) Write three differences between Breadth first search and Depth first Search.

c)

- I. What is meant by recursion in computer programming?
- II. Write three differences between recursion and iteration.
- III. What are the three main components of a recursion algorithm? Explain with an example. Hint : Factorial N ($N!$)

d)

- I. What is meant by hashing in data structures?
- II. State two main features of a Hash function.



Write the adjacency list for the above graph without considering weights.
Write the adjacent matrix for the above weighted graph.

-----End of the paper-----