University of Ruhuna- Faculty of Technology

Bachelor of Information and Communication Technology Degree

Level 2 (Semester 1) Examination, October 2018

Course Unit: ICT2113- Data Structure and Algorithms Time Allowed: **2 hours**

Answer all **four (04)** questions

This question paper contains **06 pages**.

Question 01

a) Define the following terms
   I. Algorithm.
   II. Time complexity.
   III. Big O notation.

b) Write time complexity of the following code segments in Big O notation.
   I.
```
void printPairs(int arr[], int size)
{
    for (int i = 0; i < size; i++)
    {
        for (int j = 0; j < size; j++)
        {
            printf("%d = %d\n", arr[i], arr[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) "Selection sort is faster than bubble sort "Do you agree with this statement? justify your answer.

d) Write a C program for Bubble sort, considering the algorithm given below.

```
void bubblesort (double arr[], int size)
{       i=0;
        for ( i < No of times to repeat)
                j=0;
                for ( j< No of times to repeat)
                 if current > next
                        swap current, next
}
```

e) Write down one advantage and one disadvantage of following sorting algorithms.
Bubble, Insertion, Selection, Quick, Heap and Merge sorting.

f) Consider the following array

-2 5 7 18 19 29 46 78 102 112

Show all steps on how to search for 103 in the above array using "Binary Search" method.

Question 02

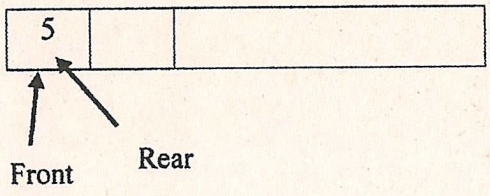
a) Write down meanings of following stack operations.
   I. Push
   II. Pop
   III. IsEmpty
   IV. IsFull

b) Convert the following **infix** expressions into equivalent **prefix** and **postfix** forms.
   I. A + B * C + D
   II. A * B + C * D
   III. (A + B) * (C + D)

c) Write down the output of the following sequence of stack operations.
push (5), push(3), pop(), push(2), push(8), pop(), pop(), push(9), push(1), pop(), push(7), push (6), pop(), pop(), push(4), pop(), pop()

d) Briefly describe the usage of stack for following applications.
   I. Compilers.
   II. Web browsers.

e) Consider following linear queue. Draw **separate frames** and **output** when each of the following operations are applied one after the other.



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

Your answer should be as follows:

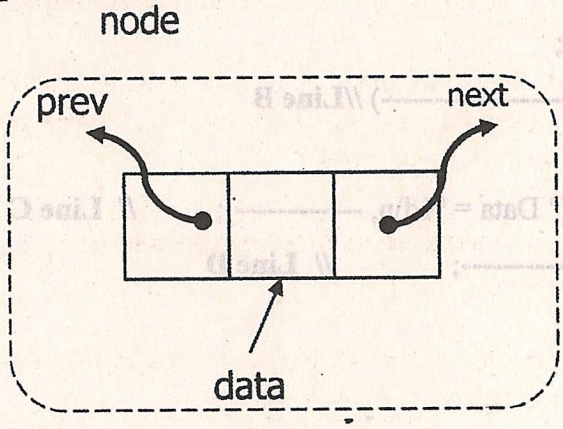
Operation	**Output**	**Frame**
enqueue(3)	-	5 | 3 |

f) What is a circular queue? Explain with an example.

Question 03

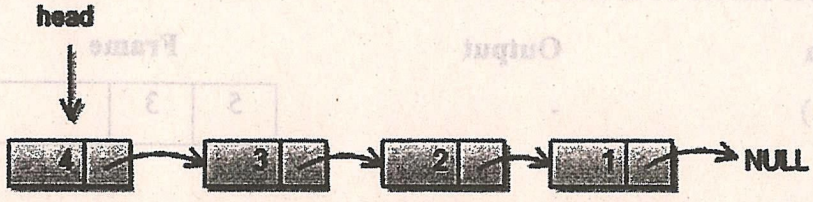
a)

I. What is a Link list? Explain functionality of a link list.
II. Write down two advantages of Link list over arrays.
III. Name three types of Link list and describe each.
IV. Following diagram is used to create a double link list. Complete the given C code to implement this.



```
typedef struct node {
        .....
        .....
        .....
} node;
```

V. Consider following *link list*. The function ***displayList()*** is written to display the contents of *link list*. Complete the blank lines (**A, B, C, and D**) with suitable C statements to display the content of the list.




```
void displayList()
{
  struct node *tmp;
  if( ----------) //Line A
  {
     printf(" List is empty.");
  }
 else
  {
    tmp = stnode;
       while(----------) //Line B
      {
         printf(" Data = %d\n, ----------);      // Line C
        tmp = ----------;              // Line D
      }
  }
}
```

b) Following data is inserted into a binary tree.

89 12 37 50 76 25 65

I. Draw the binary tree diagram after inserting data.

II. Print the data that you have inserted into tree in the part (I) in the following orders

i. Post Order

ii. Pre Order

III. How many leaves are there in above tree?

IV. What is the height of node 37?

V. Insert 63 to the above tree and draw the resultant tree.

VI. Draw binary trees for following expressions.

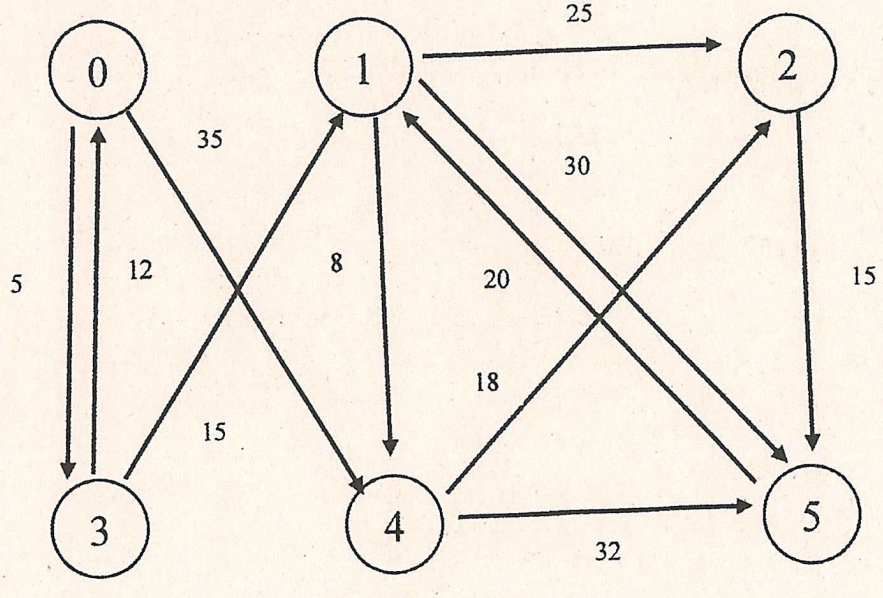
i. A * B – (C + D) * (P / Q)

ii. A + (B * (C / D))

Question 04

a) Write three types of real word applications that use in graph data structure.

b) 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 their weights.

III. Write one advantage and disadvantage of adjacent matrix representation.

c)

I. How do you define recursion in computer programming?

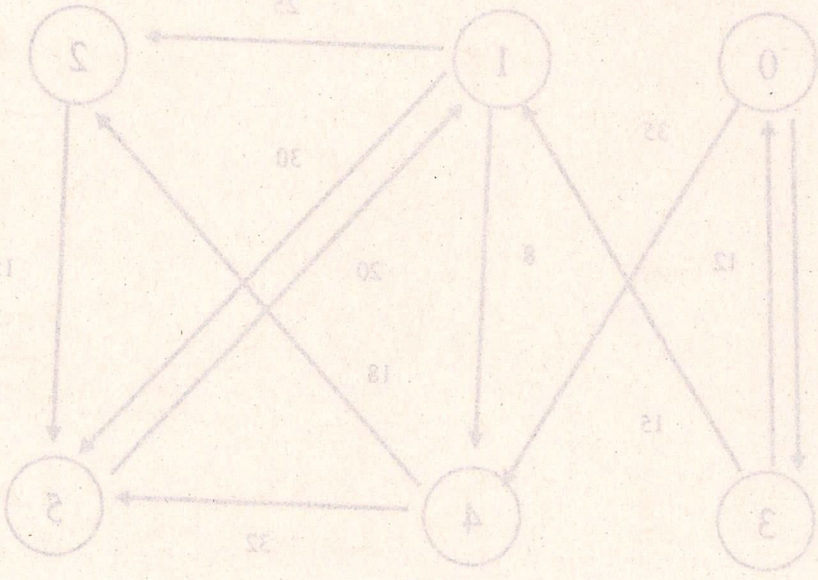
II. What are the three main components of a recursive algorithm?

III. Write down above three components that you mentioned in c (II) for **Factorial N (N!).**

d)

I. What is a Hash function?

II. Write two main features of Hash function.



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