

THE OPEN UNIVERSITY OF SRI LANKA  
 B.Sc. DEGREE PROGRAMME: LEVEL 04  
 FINAL EXAM : 2012/2013  
 CSU2279: DATA STRUCTURES AND ALGORITHMS



DURATION: THREE HOUR ONLY

Date: 7<sup>th</sup> December 2013

Time: 1.30pm - 4.30pm

Answer FOUR questions only.

**Q1.**

- (i) State the **Advantages** and **Disadvantages** of *doubly linked list*.
- (ii) Using an appropriate diagram explain the need of *Header* and *Nil* pointers. Is there any difference between them?
- (iii) Write a procedure for the operation **INSERT** for an array based linked list.
- (iv) Write a function for the operation **LOCATES** for an array based linked list.
- (v) Convert the following pointer based definition into its array based definition.

Type

```

Celltype = record
  Value : valuetype;
  Next  : ^celltype;
End;
List : ^celltype;
  
```

**Q2.**

- (i) What are abstract data types (ADT)? Describe two properties of ADT.
- (ii) Create an ADT to store mathematics marks of O/L students. The ADT should consist of student's name, index number, and marks obtained. Assume that there are 50 students in the class.
- (iii) Write a procedure to display the result sheet in the ascending order of marks.
- (iv) What do you mean by the term "Recursive Function"?
- (v) Write a recursive function to find the factorial of a given number 'n'

**Q3.**

a)

- (i) State two instances where the stack data structure can be used.
- (ii) Define an array implementation of a stack which can hold a maximum of 50 Integers.
- (iii) Using the above definition write Pascal functions to perform the following tasks.
  - 1. A function **IsEmpty** to check whether the given stack is empty or not.
  - 2. A function **POP** to delete an item from the stack.

b)

- (i) Write a function for operation **CONCAT (s1, s2)**.
- (ii) Write a function for operation **COPY (s1, start, extent, s2)**.

**Q4.**

- (i) Discuss why it is important to analyze an algorithm before it is implemented for a particular situation.
- (ii) Explain the factors on which the running time of a program depends.
- (iii) Explain the following terms with examples.
  - a. Best case running time.
  - b. Average case running time.
  - c. Worst case running time.

(iv) Perform a Big-O analysis for each of the following functions.

a.  $\frac{40(n+3)(n-2)^2}{(n^2-4)}$

b.  $3n^2+2n-1$

(v) Calculate the running time of the following function.

a. function fac(i:integer):integer;

```

    var
    x : integer;
begin
    fac := 1;
    for x := 1 to i do
    fac := fac*i;
end;
```

Q5.

(i) Write short notes on each of the following topics.

- (a) Balance Multiway merging.
- (b) Different categories of searching methods.
- (c) The straight selection sort algorithm.

(ii) Show how the **Bubble sort** and **Linear Insertion Sort** algorithms work by *Dry Running* the integer array given below for each algorithm.

(Dry running is the process in which you run through the code of an algorithm manually, by showing the values and states of all variables and arrays in a table for a given input).

By using your Dry running chart, explain the difference between Bubble sort algorithm and Linear Insertion Sort algorithm.

|    |    |    |    |   |
|----|----|----|----|---|
| 25 | 13 | 19 | 16 | 8 |
|----|----|----|----|---|

**Bubble Sort algorithm**

```

for i:= 1 to n-1 do
    for j:=n down to i+1 do;
        if A[j].key<A[j-1].key then
            swap(A[j],A[j-1])

```

**Linear Insertion Sort algorithm**

```

A[0].key := -10000;
for i:= 2 to n do
    begin
        j := i;
        while A[j] < A[j-1] do
            begin
                swap (A[j] , A[j-1]);
                j := j-1;
            end;
    end;
end;

```

**Q6.**

(i) Briefly explain the following terms with relevant conditions with respect to a binary tree structure.

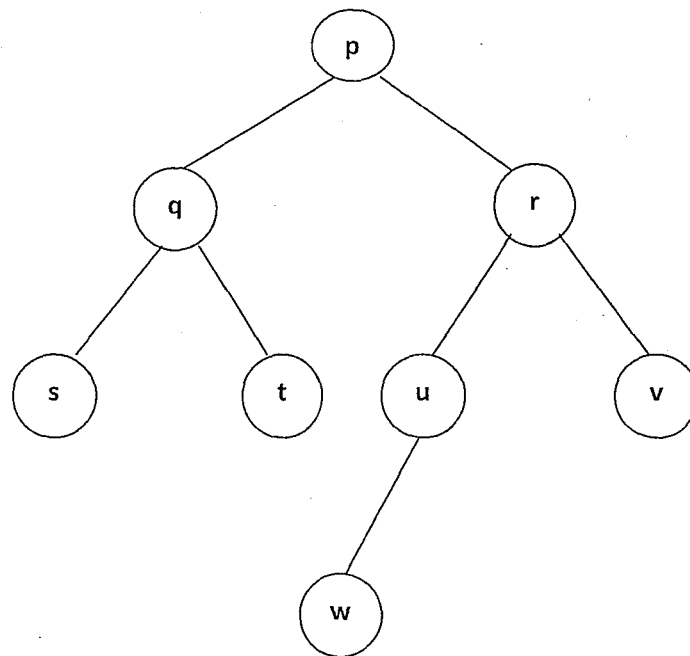
- (a) Strictly binary
- (b) Complete binary.

*Note : Draw suitable diagrams to show the above situations.*

(ii). Represent the following mathematical expressions using binary trees.

- (a).  $p * q + r$
- (b).  $(a + b * c) \$ ((a + d) * c)$  Here , the \$ sign represents the exponential.
- (c).  $x * y - (p - q) * (r / s)$

(iii). Answer the following questions about the given tree structure B1.



**B1 Tree**

- (a). Give the preorder, inorder, postorder traversal of the tree B1.
- (b). Is B1 a *Strictly* binary tree? Justify your answer.
- (c). How many leaf nodes are there?
- (d). How many levels are there in the tree?