

THE OPEN UNIVERSITY OF SRI LANKA  
 B.Sc DEGREE PROGRAMME: LEVEL 03  
 FINAL EXAMINATION: SEMESTER 2 - 2012/2013  
**CPU1142: DATA STRUCTURES AND ALGORITHMS**



DURATION: TWO HOURS (2 HOURS)

Date: 07<sup>th</sup> December, 2013

Time: 1.30 pm – 3.30 pm

Answer FOUR Questions ONLY.

Q1.

- a) Write short notes on the following;
  - i. Data Structure
  - ii. Abstract data type
- b) List down the three (03) basic operations that can be performed with data structure.
- c)
  - i. Explain the solutions to overcome the main problems caused, when selecting a data structure.
  - ii. List out three (03) areas in which data structures are applied.
- d) What do you mean by complexity of an algorithm?
- e) Explain the meaning of worst case analysis and best case analysis with an example.
- f) Determine the running time of the following C program code.

```
for (i=n; i>0; i=i-1)
{
    y = y+1;
}
```

Q2.

- a) Consider the following structure of a linear linked list:

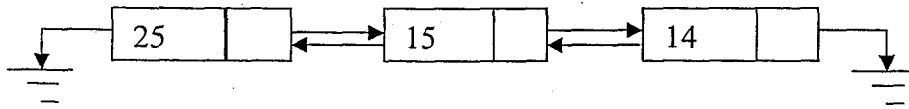
```
struct list_el {
    float value;
    struct list_el * next;
};
```

- i. Create a linear linked list.

Write a function in C language to perform the following;

- ii. Insert a node at the beginning of the linear linked list.
  - iii. Print the elements in the linear linked list.
- b) What is meant by a circular linked list?
  - c) What are the disadvantages of circular linked list?

- d) Consider the following diagram of a doubly linked list:



Graphically show each step to remove node 15 from the above list.

Q3.

- Which data structure would be most appropriate to implement a simulation that determines expected time for customers to wait for a teller to serve them in a bank?
- Define a stack.
- Write functions in C language to implement the operations that store data in a stack and retrieve data from a stack.
- Suppose you push 10, 20, 30, and 40, in that order, onto the stack. Then you pop three items. Which one is left on the stack?
- Suppose you insert 15, 25, 35, and 45, in that order, into a queue. Then you remove three items. Which one is left?
- What are the disadvantages of a queue?

Q4.

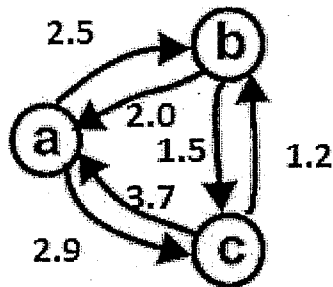
- What is the depth of a complete binary tree with fifteen nodes?
- How many nodes are there in a complete binary tree of depth 7?
- What is a binary search tree (BST)?
  - Draw the binary search tree, of characters, that would be formed by inserting the following values in order:  
' S', ' E', ' L', ' I', ' T', ' B', ' M'.
  - Write the values when the tree you created in question Q4 (c) (ii) above is traversed in,
    - Preorder
    - Inorder
    - Postorder
- Evaluate the following postfix expressions.
  - $5\ 3\ +\ 2\ *$
  - $1\ 4\ +\ 5\ -$
  - $6\ 3\ / \ 2\ +$
  - $2\ 5\ 3\ -\ *$
  - $5\ 4\ 6\ +\ * \ 4\ 9\ 3\ / \ +\ *$

- e) Represent the following expression using a tree. Comment on the result that you get when this tree is traversed in preorder, inorder and postorder.

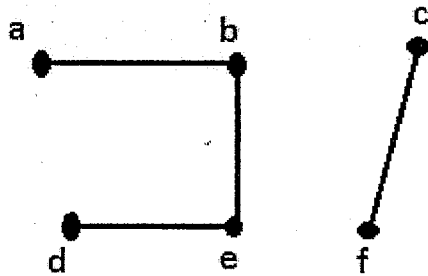
$$(a - b) / ((c * d) + e)$$

Q5.

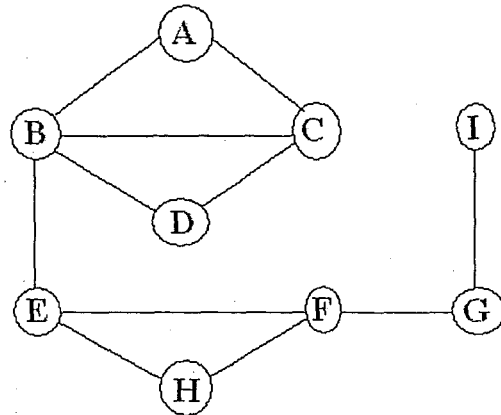
- a) A graph consists of a set of objects (called vertices) and a set of edges, with a weight assigned to it. Consider the graph given below:
- What is the out degree of vertex  $a$ ?
  - Find the weight of the shortest path from vertex  $c$  to vertex  $a$ ?



- b) With respect to the graph below, answer the following questions;
- Is it cyclic?
  - Is it connected?
  - List, in order, the vertices in the longest path.



- c) Consider the following graph and answer the questions given below.
- Give the adjacency matrix and adjacency list of the graph.
  - Using the adjacency list representation, apply the depth-first search and breadth-first search to the graph and list the vertices they would be visited starting from node A.



Q6.

- a) Sorting methods can be classified into two categories. What are those? Briefly explain them.
- b) State whether the following statements are true or false.
  - i. The bubble sort always ends up comparing every item with every other item.
  - ii. If there are  $N$  items, the bubble sort makes exactly  $N*N$  comparisons.
  - iii. If, in a particular sorting situation, swaps take much longer time than comparisons, the selection sort is about twice as fast as the bubble sort.
  - iv. In the insertion sort, after an item is inserted in the partially sorted group, it will never be shifted towards the first element of the array.
  - v. In the selection sort, a minimum key is repeatedly discovered.
- c) Show the various passes of bubble sort on an unsorted list given below;

11, 15, 2, 13, 6

- d) In a maximum heap, what is the relationship between values stored in a parent and its child nodes?
- e) Create a maximum heap with following list of keys:

8, 20, 9, 4, 15, 10, 7, 22, 3, 12

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