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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Information and Communication Technology

First Year Semester II Examination - Oct./Nov. 2017

ICT 1305 – DATASTRUCTURES

Time: Three (03) hours

Instructions:
Answer **All Five** Questions.
This paper consists of **three** (3) pages.

1. a. What are the factors that you should consider when selecting a data structure for an algorithm? (04 marks)

   b. Explain, using examples, how a selected data structure increases or decreases the efficiency of an algorithm. (04 marks)

   c. Explain the term *abstract data types* using an example. (03 marks)

   d. Suppose you need to read a given text and count the frequency of occurrences of each word appeared in the text. Suggest a suitable structure to store the list of words along with their frequencies. Explain its usage. (04 marks)

   [Total 15 marks]

2. a. Compare and contrast array based lists and dynamic lists. (02 marks)

   b. Suppose that a programmer has designed a dynamic list that only allows adding elements before the head element. Assume that a node of the list contains two integers, n1 and n2, and n1 is considered as the key.

      i. Write a function that removes the highest key element and inserts it into another list. (06 marks)

      ii. Write a recursive function to print the contents of the list in reverse order. (04 marks)

   c. Suppose that p and q are two consecutive elements of an array-based list. Write a few lines of pseudo code to insert a new element between p and q if the length of the array is n and the array is not full. (04 marks)

   d. Suppose that p is a middle node of a doubly linked list. Write a few lines of pseudo/C code to delete the node p. (04 marks)

   [Total 20 marks]

3. a. Briefly discuss how *queue* and *stack* data structures are used in computer Operating Systems to perform various operations. (04 marks)

   b. A programmer needs to read a set of student records and keep them in a queue until they are processed. A student record consists of index number and marks for five subjects. A processed record only contains the index number and the total marks of five subjects. Once a record is processed it is pushed to a stack.

   Write a few lines of C codes / C function for the followings:

   i. Implement required node structures of the *queue* and *stack* of the above scenario. (05 marks)

   ii. Implement a function to process a node of the queue and to return a stack node. (06 marks)

   c. If the programmer needs to print the set of processed records in descending order of their total marks, suggest a suitable method. (05 marks)

[Total 20 marks]

4. a. Compare and contrast *Queues* and *Priority Quests*. (03 marks)

   b. A *Priority Queue* can be implemented using a heap. Explain how to use heap property to implement a priority queue. (02 marks)

   c. Explain how the highest priority element is removed from an *array-based heap*. (04 marks)

   d. Illustrate how to insert the given list of integers [15, 12, 4, 20, 18, 2, 10 ,5] in to an array-based priority queue. Show the steps clearly. (05 marks)

   e. Explain the terms *in-place sorting* and *stable sorting*. (04 marks)

   f. Illustrate how to sort the given list of integers [15, 12, 4, 20, 18, 2, 10 ,5] using *merge sort* algorithm. (04 marks)

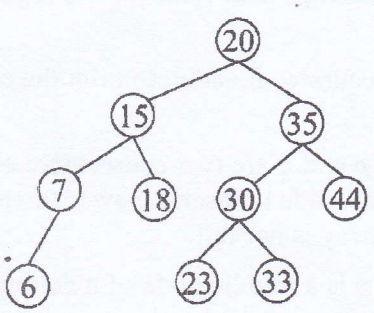
[Total 22 marks]

5. a. Explain how *binary search trees* (BST) differ from *trees*. (02 marks)

   b. If a BST node contains two fields, *height* and integer *key*, write a C-code to implement the structure of the BST node. (03 marks)

   c. Explain In-order, Pre-order and Post-order traversals of a BST using examples. (03 marks)

   d. Consider the given BST;



Apply the following algorithm to the given tree and write the expected output. Show the contents of the *queue*, *Q*, at each iteration. Assume that *enqueue* and *dequeue* functions are available. (08 marks)

```
Q=T->root //T - a BST, Q - A dynamic queue constructed
using BST nodes

While (Q<> NULL)

      Front=dequeue(Q)

      Print Front->key //key is the content of a BST node

      If(Front ->left<>NULL)

            enqueue (Q, Front ->left)

      If(Front ->left<>NULL)
```

e. What is an *AVL tree*? (02 marks)

f. Illustrate how to inset the list [15, 12, 4, 20, 18, 2, 10, 5, 7] in to an *AVL tree*. Show each step clearly. (05 marks)

[Total 23 marks]

-- End --