Uva Wellassa University, Sri Lanka
End Semester Examination – August/September 2011
CST225-2 Data Structures & Algorithms
CST202-2 Data Structures & Algorithms (Repeat)
Time: Two (02) hours

Total **05** Questions
Answer **all** questions

Question 1. **(20 marks)**

(a) Define the following terms;

i) Algorithm ii) Program iii) Data Structure

(b) State ***three*** usages of data structures and briefly describe them.

(c) Assuming the RAM model of computation, analyze the ***running time*** of the following program fragment. Clearly show the steps in each statement.

```
sum ← 1
for i←1 to n+5
        do sum ← sum + a[i]
```

(d) Write an algorithm to find a given value stored in a two dimensional array and calculate the complexity of that algorithm using ***Big 'O'*** notation.

(e) State the ***advantages*** and ***disadvantages*** of following data structures.

i) Array ii) Ordered Array iii) Stack iv) Queue v) Linked List

Question 2. **(20 marks)**

(a) You are given an empty stack which can hold 5 integer elements. Draw a sequence of frame sets that demonstrate how the following operations affect the stack.

i)	pop();	v)	peek();
ii)	push('34');	vi)	push('134');
iii)	push('66');	vii)	peek();
iv)	pop();	viii)	pop();

(b) How to overcome the problem in using "***linear queues***" by using "***circular queues***"?

(c) Draw a sequence of queue frames showing the progress of each of the following segments of code. Clearly show the both front and rear pointers. Consider the queue is implemented as a ***circular queue***.

i) insert('B'); ii) peekFront(); iii) remove(); iv) insert('Y'); v) remove();

(d) Write the algorithms for following queue operations;

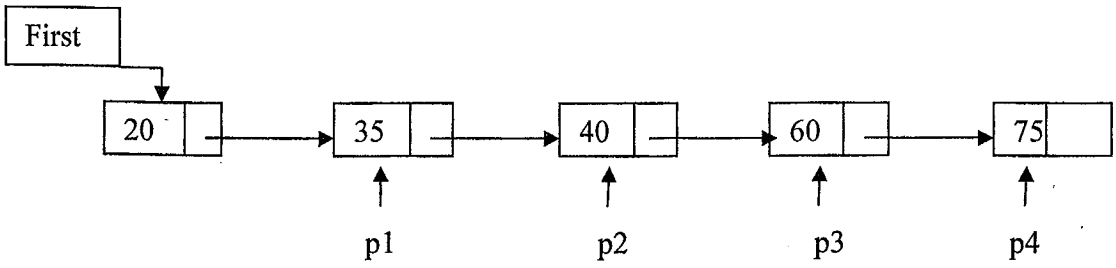
i. Inserting an item into a queue.
ii. Deleting an item from a queue.

(e) What is the ***minimum number*** of queues needed to implement the priority queue? Briefly explain.

Question 3. **(20 marks)**

(a) Describe the properties of a ***linked list*** and state the usages of linked lists in computer systems.

(b) You are given the following linked list of link objects and references ***p1, p2, p3, and p4***. For each code segment, draw a similar figure indicating how the list changes.



i. p2 = p1.next;
ii. first = p1.next;
iii. p3.data = p1.data;
iv. p3.data = p1.next.data;
v. p1.next.data = p1.data;

(c) Give an algorithm to ***reverse*** the elements of a single linked list without using a temporary list.

(d) Write the algorithm to search a given element from a data array using ***binary search.***

(e) Show step by step how binary search would search for item; ***'95'*** from the data array given below.

Data Array; ***Bottom*** ***Top***

10	20	40	67	78	79	85	90	95	125
0	1	2	3	4	5	6	7	8	9

Question 4. **(20 marks)**

(a) State the situation where you cannot gain any performance increase in ***insertion sorting.***

(b) How are you going to gain an increase in performance in ***shell sorting*** compared to ***insertion sorting***?

(c) Write the algorithm for ***bubble sort*** and explain with an example.

(d) Write the algorithm for ***merge sort.*** Apply ***merge sort*** on following array. (Show all steps)

0	1	2	3	4	5	6	7	8	9	10	11
64	21	33	70	12	85	44	3	97	24	51	40

(e) Complete the following table of efficiencies.

Sorting Method	**Efficiency (Big O)**	
	Worst Case	**Best Case**
Insertion		
Shell		
Merge		
Quick		

13

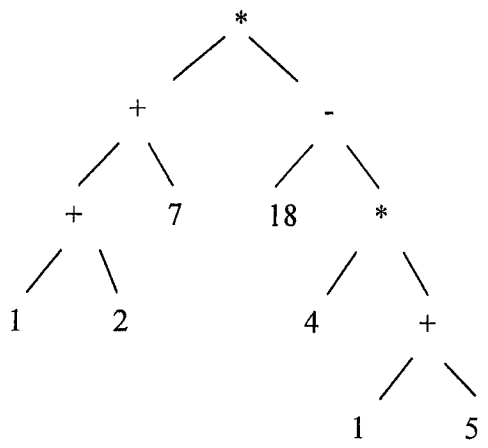
Question 5. **(20 marks)**

(a) What are the ***three*** types of binary trees available? Give ***one*** condition that each tree should satisfy.

(b) Insert following numbers into a binary tree.

70, 50, 30, 100, 80, 75, 110, 10, 25, 35

(c) Consider the following expression tree;



What is the sequence of symbols that would result, when traversed as;

i. **In-order**

ii. **Pre-order**

iii. **Post-order**

(d) Give the iterative algorithm for the ***in-order*** traversal of a binary tree.

(e) Write the algorithms to following ***deletion operations*** in a binary tree;

i. Node to be deleted is a leaf node.

ii. Node to be deleted has one child.

---End of Question Paper---