UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)

Academic Year 2014/2015 – 2nd Year Examination – Semester 4

IT4105 – Programming II
Part 2 - Structured Question Paper

1st August, 2015
(ONE HOUR)

To be completed by the candidate

BIT Examination Index No: ....


Important Instructions:

- The duration of the paper is **1 (one) hour**.
- The medium of instruction and questions is English.
- This paper has **2 questions** and **16 pages**.
- **Answer both questions.**
- **Write your answers** in English using the space provided **in this question paper**.
- Do not tear off any part of this answer book.
- Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.
- Note that questions appear on both sides of the paper.
  If a page is not printed, please inform the supervisor immediately.

Questions Answered

Indicate by a cross (✗), (e.g. ✗) the numbers of the questions answered.

	Question numbers		
To be completed by the candidate by marking a cross (✗).	1	2	
To be completed by the examiners:			

1) (a Consider the following diagram and the ListNode class data structure definition.
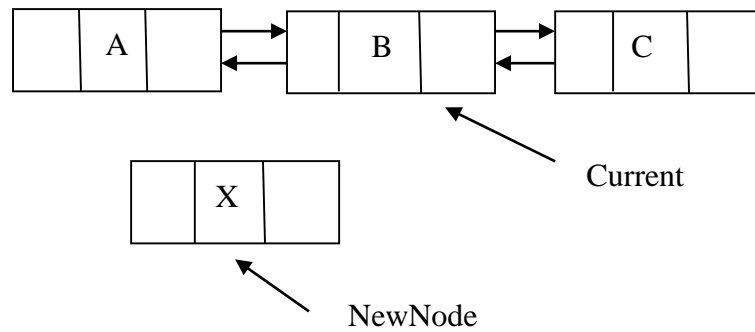

```
Class ListNode
{
    Object ListNode;
    ListNode=next;
    ListNode=previous
}
```

Write down a Java Code or Pseudo Code to perform the following independent operations.

Your answer should also be supported along with suitable diagrams.

(i) Describe, how the element "X" is inserted immediately before the Element "B".

[3 Marks]

ANSWER IN THIS BOX

Newnode.next=current

Newnode.previous=current.previous

current.previous.next=newnode

Current.previous=newnode

Or similar method

(ii) Describe how the element "X" is inserted immediately after the element "B" in the initial list.

[3 Marks]

ANSWER IN THIS BOX

Newnode.next=current.next

Newnode.previous=current

Current.next.previous=newnode

Current.next=newnode

Or similar method

(iii) Describe, how you can delete the element   "B" from the initial list.

[3 Marks]

ANSWER IN THIS BOX

Current.previous.next=current.next

Current.next.previous=current.previous

Or similar instructions

(iv) You may assume that the above doubly linked list consist of the header and the tail node
to indicate both ends. What is the relationship between the header and the tail if the
doubly lined list is empty?

[3 Marks]

ANSWER IN THIS BOX
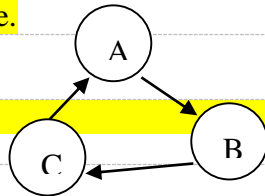
Heder.next=tail

Tail.previou=head

(b (i) Define the terms Cyclic Path, Adjacency Matrix and Path Matrix used in Directed Graphs.

[3 Marks]

ANSWER IN THIS BOX

Cyclic Path :

A **directed cycle** is a **directed path** (with at least one edge) whose first and last vertices are the same.
e.g.

Adjacency Matrix

A representation of a directed graph *with n* vertices *using an n × n* matrix*, where the entry at (i,j) is 1 if there is an* edge *from vertex i to vertex j; otherwise the entry is 0.*
Eg. Adjacency matrix for the above diagram

|	A	B	C
A	0	1	0
B	0	0	1
C	1	0	0

Path Matrix

All possible path from 1 to n,
 Suppose we wish to construct the path matrix such that path[i][j] equals true if and only if there is a path from node i to node j of any length
Path[I][j]=adj[I][j] or $adj_2[I][j]$ or $adj_3[I][j]$ or $adj_4[I][j]$ ...

e.g. path matrix for the above diagram

	A	B	C
A	1	1	1
B	1	1	1
C	1	1	1

5

Consider the following directed graph. It shows the name of cities and the possible paths from one city to another. The graph is labelled Graph P.
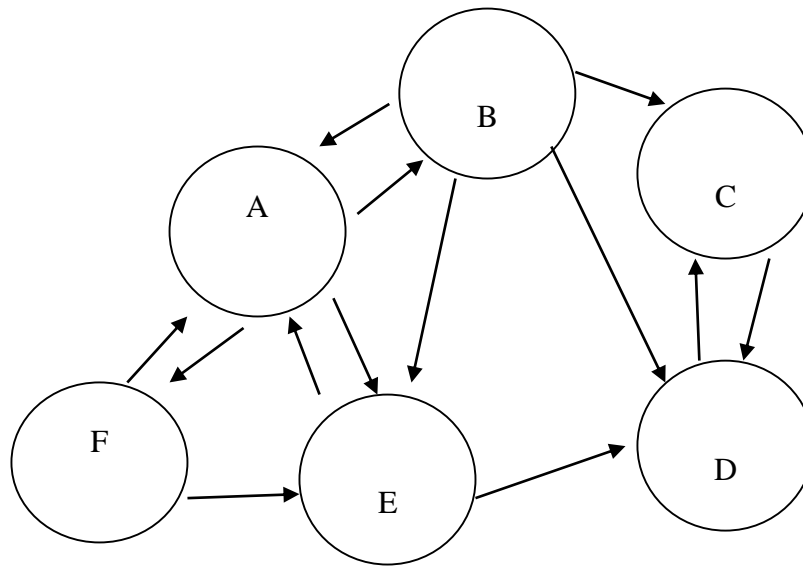
Graph P

(ii)   Find the Adjacency Matrix of Graph P.

[3 Marks]

ANSWER IN THIS BOX
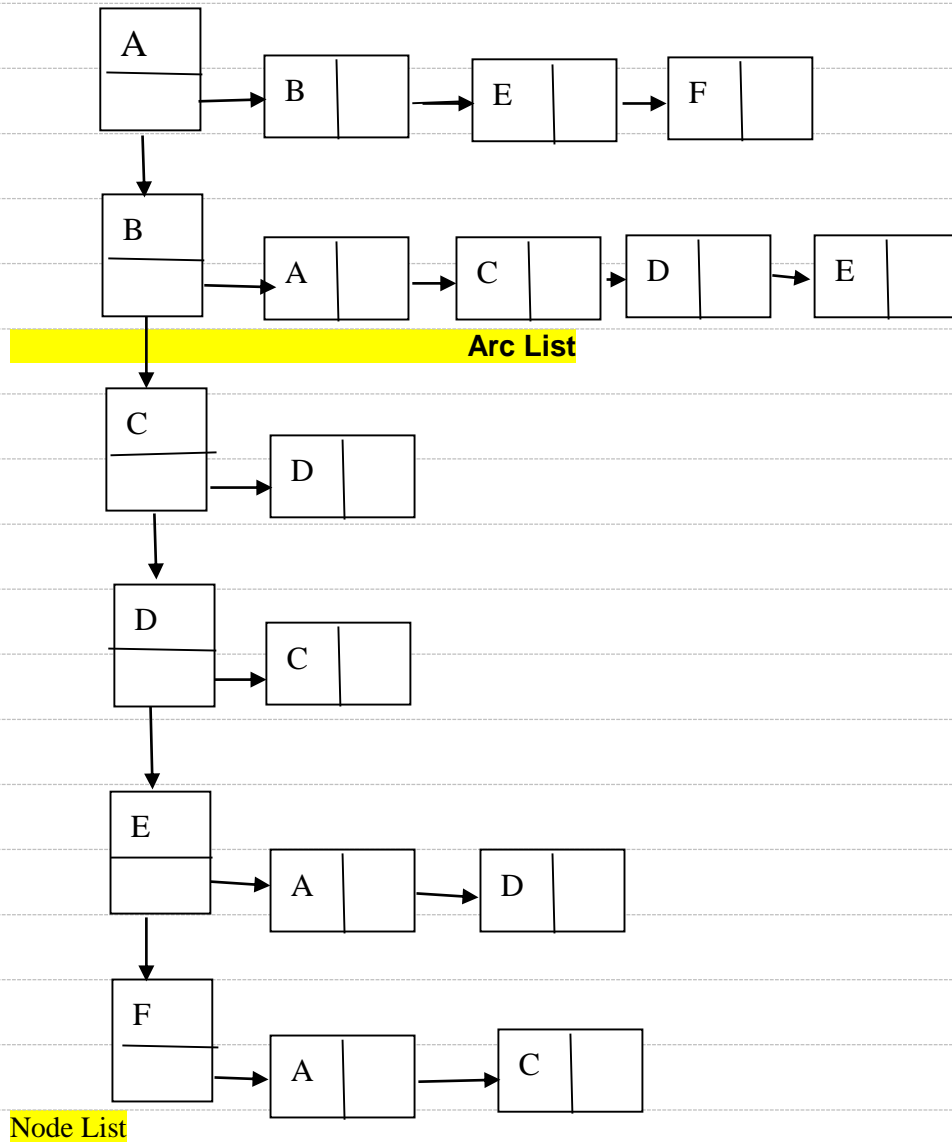
	A	B	C	D	E	F
A	0	1	0	0	1	1
B	1	0	1	1	1	0
C	0	0	0	1	0	0
D	0	0	1	0	0	0
E	1	0	0	1	0	0
F	1	0	0	0	1	0

(iii) How would you represent the above directed graph P using a linked list representation? You should use a suitable diagram to answer the question.

[3 Marks]

ANSWER IN THIS BOX

Arc List

Node List

(iv) Traverse the above directed graph in Breadth First Traversal Order using a queue. Show the final answer with intermediate results.

[4 Marks]

ANSWER IN THIS BOX

1 Create an empty queue.
2 Start the traversal at node A and mark it as a visited node.
3 All connected nodes to node A are added to the queue, if it is not already visited or is not in the queue.
At end of step 3, the following shows the elements of the queue.

B	E	F			

4 Pop B and add all connected nodes with B to the end of the queue. Mark B as a visited node.

E	F	C	D

5. Pop E (mark E as a visited node).

6 Add all connected nodes with E to the end of the queue. The connected nodes are A and D . D is already in the queue and A is already visited.

7 Apply the above method until the queue becomes empty

The final order of nodes is : A B E F C D .

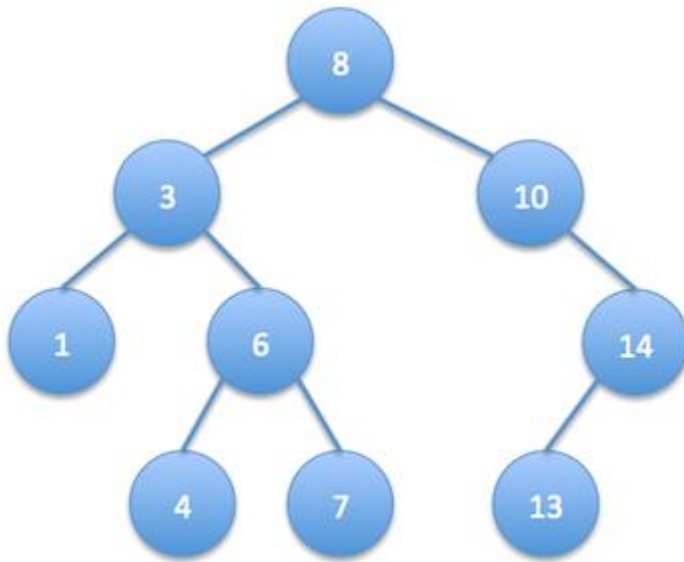2) (a) Consider the following binary search tree as shown in Figure H:

Figure H: Binary Search Tree

(i) Write down the order of nodes visited for the tree if the tree is traversed in the following sequence.

- Pre-order
- In-order
- Post-order

[3 Marks]

ANSWER IN THIS BOX

Pre-order
8,3,1,6,4,7,10,14,13

In-order

1,3,4,6,7,8,10,13,14

Post-order

1,4,7,6,3,13,14,10,8

(ii) One wants to find the maximum value from the above binary search tree in a recursive manner. You have been assigned to do this task and hence you are required to develop a recursive algorithm to find the maximum from any binary search tree. Using the proposed algorithm, illustrate how you could find the maximum value from the above tree.

[4 Marks]

ANSWER IN THIS BOX

One can perform, find operation by starting at the root and then repeatedly branching to the right.

Start at 8.
Then go right. (reference is at node 10).
Then go right. (reference is at node 14).
Then go right and encounter null reference. Thus 14 is the maximum.
Terminate the procedure.

(iii) Write a JAVA code to find the maximum value from a binary search tree in a recursive manner.

[4 Marks]

ANSWER IN THIS BOX

```
Private BinaryNode findMax(BinaryNode t)
{
If (t = = null)
return null;
else if (t.right= = null)
return t;
return findMin(t.right);
}
```

(iv) How could you modify Part (ii) above to find the maximum value in non-recursive manner? You should include the appropriate pseudo code or Java code.

[3 Marks]

ANSWER IN THIS BOX

```
private BinaryNode findMax(BinaryNode t)
{
if (t!=null)
While (t.right!=null)
t=t.right;
return t;
}
```

(v) Consider the following pseudo code algorithm:

```
1.  add(T, v, e){
2.  if(T.isLeaf(v)){
            if(v.element()>=e)
                    add element e as v's left child
            else
                    add element e as v's right child
3.  } else {
            if(v.element()>=e)
                    add(T, T.leftChild(v), e)
            else
                    add(T, T.rightChild(v), e)
4.  }
5.  }
```

One wants to insert node 9 to Graph H. Describe how you could insert the node according to the steps (step shows the line numbers of the pseudo code) in the algorithm above?

[4 Marks]

ANSWER IN THIS BOX

At the insertion of Node 9
1) Line 1: comparison starts at node 8
2) Line 2: node 8 is root but not a leaf node
3) Line 3: compares whether 9 is greater than the root value (i.e. 8>9) no; therefore else condition is executed, similarly, recursively 9 will be added as the left child of node 10
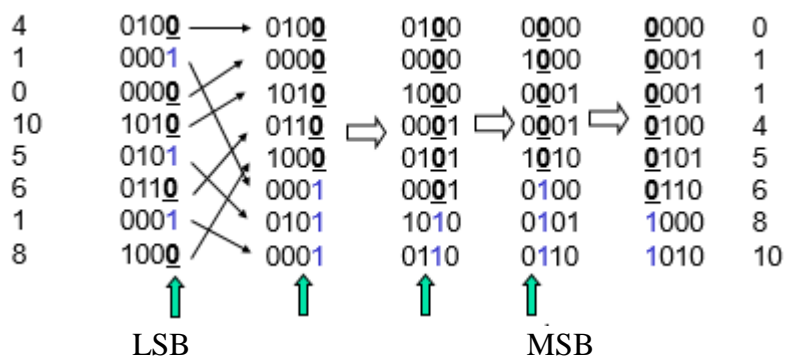
Or similar method

Additional Spaces are provided for if one wants to describe using a suitable diagram.

(b) One wants to sort N numbers using the radix sort algorithm. You may that assume that each number has k-bits. For example, one can consider the following data set.

Input :{ 4, 1, 0, 10, 5, 6, 1, 8}

The above data set can be sorted using the straight radix sort as below.

4	0100	0100	0100	0000	0000	0
1	0001	0000	0000	1000	0001	1
0	0000	1010	1000	0001	0001	1
10	1010	0110	0001	0001	0100	4
5	0101	1000	0101	1010	0101	5
6	0110	0001	0001	0100	0110	6
1	0001	0101	1010	0101	1000	8
8	1000	0001	0110	0110	1010	10

LSB   MSB

Write a suitable pseudo code algorithm or Java code to sort any given integer data set using the methodology described above.

[4 Marks]

ANSWER IN THIS BOX

1 convert all the values into binary as shown in the diagram above.

2. Consider the LSB and if it is zero then write in the 2nd column as shown in the diagram. If all values ending with zero are over, then copy the remaining values with LSB is 1. Second column of the diagram shows outcome of this stage.

3 Now the intermediate file consists of two parts, one is value ending with 0 bit and the other one is ending with 1 bit.

Consider the next LSB as shown in the diagram and apply the method described above and obtain the third column.

Similarly, apply the above process until the MSB is reached.
Then finally, the sorted list can be obtained after converting the binary values into decimal values.

If students have answered using either pseudo code or java code to cover the above process, 4 marks will be assigned.

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(c) Draw the **final binary min heap** that results after inserting: 95, 16, 7, 59, 21, 45, 06, and 4 into an initially empty binary min heap in the given order. Show **only** the final heap. Intermediate heaps are not required.

[3 Marks]

ANSWER IN THIS BOX

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