UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (*EXTERNAL*)

Academic Year 2004/2005 – 1st Year Examination – Semester 2

IT2202 – Data Structures and Algorithms

Multiple Choice Question Paper

30th July, 2005
(TWO HOURS)

Important Instructions :

- The duration of the paper is 2 (two) hours.
- The medium of instruction and questions is English.
- The paper has **45** questions and **12** pages.
- All questions are of the MCQ (Multiple Choice Questions) type.
- All questions should be answered.
- Each question will have 5 (five) choices with **one or more** correct answers.
- All questions will carry equal marks.
- There will be a penalty for incorrect responses to discourage guessing.
- The mark given for a question will vary from –1 (*All the incorrect choices are marked & no correct choices are marked*) to +1 (*All the correct choices are marked & no incorrect choices are marked*).
- Answers should be marked on the special answer sheet provided.
- Note that questions appear on both sides of the paper.
  If a page is not printed, please inform the supervisor immediately.
- Mark the correct choices on the question paper first and then transfer them to the given answer sheet which will be machine marked. **Please completely read and follow the instructions given on the other side of the answer sheet before you shade your correct choices.**

1) Consider the following four statements.

(i) A stack is an ordered collection of items into which new items may be inserted and from which items may be deleted at the one end called top of the stack.
(ii) A stack is an ordered collection of items into which new items may be inserted into an arbitrary location.
(iii) Dynamic implementation stacks using Java language are practically impossible.
(iv) One of the stack applications is used in complier design.

Which one of the following is correct in relation to the stacks?

(a) (i) and (iv) only	(b) (i), (ii) and (iii) only	(c) (i) only
(d) (iv) only	(e) (i), (ii) and (iv) only	

2) Consider the following infix expression:

((A+B) * C – (D-E)) ^(F + G)

Which of the following is a / are correct equivalent expression(s) for the above?

(a) ^ - * + A B C – D E F G+	(b) ^ - * + A B C – D E F+ G
(c) ^ - * + A B C – D E + F G	(d) - ^ * + A B C – D E + F G
(e) ^ - * + A B C – D E + F G	

3) Which of the following statements is/are correct in connection with stacks?

(a) Return and remove the most recently inserted item from the stack, if stack is not empty.
(b) Insert a new item to the top of the stack, if stack is full.
(c) Elements can be deleted from both ends.
(d) Linked list based stack implementations are more convenient than array based implementations.
(e) Return and remove the least recently inserted item from the stack, if stack is not empty.

4) Which of the following is a / are possible operation(s) in connection with stacks?

(a) Reverse the order of elements on stack S using two additional stacks.
(b) Reverse the order of elements on stack S using additional variables.
(c) Reverse the order of elements on stack S using one stack and some additional queues.
(d) Sort the elements of stacks using one additional stack.
(e) Reverse the order of elements on stack S using one additional queue.

Questions No. 5 and No. 6 are based on the following postfix expression S and the initial values of the variables.

S = A B - C + D E F - + ^

Assume that A=3, B=2, C=1, D=1, E=2, F=3

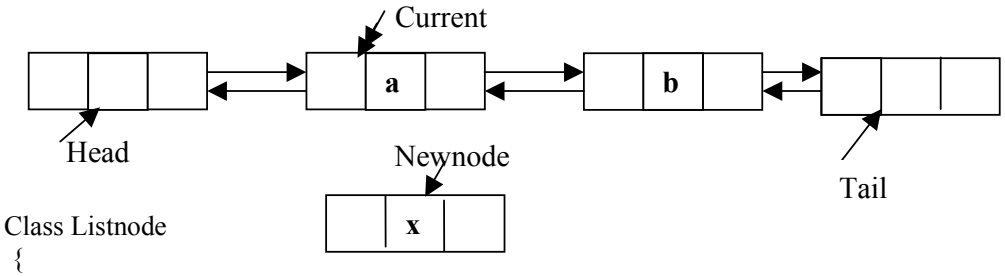
5) If the above S is evaluated using a stack, what is/are the intermediate value(s) on the top of the stack?

(a) 3	(b) 0	(c) 2
(d) -1	(e) -2	

6) What would be the final output of the stack?

(a) 1	(b) 2	(c) 0
(d) -1	(e) 3	

Questions No. 7 to No. 9 are based on the following doubly linked list and its data structure.




```
Class Listnode
 {
    Object element;
    Listnode next;
    Listnode prev;
 }
```

7) What would be the correct statement(s), when the doubly linked list is empty?

(a) Head.next=tail	(b) Current.next=tail	(c) Current.prev=Head
(d) Tail.prev=Head	(e) Current=nill	

8) Which of the following correctly describe(s) the steps to delete element **b** from the above doubly linked list?

(a) Current.next.next.prev=Current.prev Current.next = Current.next.next	(b) Current.next = Current.prev.next Current.next.next.prev=Current.prev
(c)Current.next=Current.next.next Current.next.next.prev=Current.next.prev	(d) Current.next=tail Head.next=Current.next.prev
(e) Current = Current.next.next Current.next.next.prev=Current.prev	

9) Which of the following correctly describe(s) the steps in inserting elements **x** immediately after the element **a** in the above doubly linked list?

(a)current.next=x x..prev=current x.next=b b.prev=x	(b) current.next=x x..prev=current.prev x.next=b b.prev=x	(c) a.next=x x..prev=current x.next=b b.prev=x
(d) Newnode.next= Current.next Newnode.prev=Current Newnode.prev.next=Newnode Newnode.next.prev=Newnode	(e) Newnode.next= Current.next Newnode.prev=Current.next.prev Current.next=Newnode Current.next.prev=Newnode	

10) A set of basic list terms is given in **Part A** and some definitions are given in **Part B** as follows.

Part A		**Part B**	
(i)	Circular linked list	(p)	A class that maintains a current position and performs all routines which depend on knowing the position in the list.
(ii)	Doubly linked list	(q)	A linked list that allows bidirectional traversal by storing two references per node.
(iii)	Header node	(r)	A list used to maintain items in a linked list in some arrangement.
(iv)	Iterator class	(s)	An extra node in the linked list that holds no data but serves to satisfy the requirement that every node has a previous node.
(v)	Sorted linked list	(t)	A linked list in which the last cell's reference points to the first.

Choose the best definition from **Part B** for the above five terms in **Part A**.

(a) (i)→ (t) (ii)→(q) (iii)→(r) (iv)→(p) (v)→(s)	(b) (i)→ (p) (ii)→(t) (iii)→(s) (iv)→(p) (v)→(r)
(c) (i)→ (t) (ii)→(q) (iii)→(s) (iv)→(p) (v)→(r)	(d) (i)→ (q) (ii)→(t) (iii)→(s) (iv)→(p) (v)→(r)
(e) (i)→ (t) (ii)→(s) (iii)→(p) (iv)→(p) (v)→(r)	

Questions No. 11 and No. 12 are based on the following straight queue which can be allocated eight integers and five operations.

front = 3 rear= 5

Queue = - , - , 2 , 4 ,5, - , - , -

(for notational convenience " – " used to denote an empty cell)

The following operations have to be performed.

(i) 6 is added to the queue.
(ii) Two elements are deleted from the queue.
(iii) 10 and 12 are added to the queue.
(iv) Two elements are deleted from the queue.
(v) 2 and 3 are added to the queue.

11) What are the final front and rear values when the above operations are performed into a straight queue?

(a) front = 7 rear=2	(b) front = 2 rear=7	(c) front = 2 rear=8
(d) front = 5 rear=8	(e) front = 7 rear=8	

12) What are the final front and rear values when the above operations are performed into a circular queue?

(a) front = 7 rear=2	(b) front = 2 rear=7	(c) front = 2 rear=8
(d) front = 5 rear=8	(e) front = 7 rear=8	

13) Consider the following Java program.

```
Public void pqr ( object x )
    {
   if (isempty( ))
      rear=front= new Listnode( x) ;
   else
     rear=rear.next=new ListNode( x );
    }
```

What is the above Java program segment intended to do?

(a) creating a new node
(b) deleting nodes from the queue
(c) only inserting a new item x into an initially empty queue
(d) only inserting a new item x into an initially non empty queue
(e) inserting a new item x into the queue

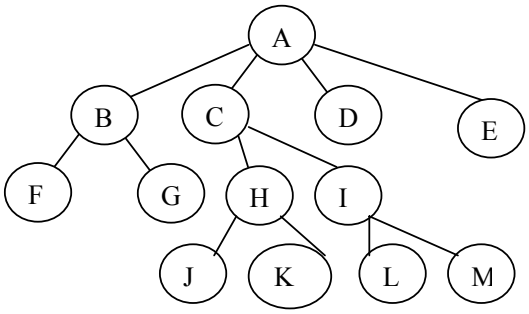
14) Consider the following paragraph.

The traversal proceeds as far as possible to the left, then backs up until the first cross road, goes one step to the right and again as far as possible to the left. Repeat this process until all nodes are visited.

What does the above paragraph describe?

(a) Breadth first traversal	(b) Critical path traversal
(c) Shortest path traversal	(d) Depth first traversal
(e) Depth and breadth hybrid traversal	

Questions No. 15 and No. 16 are based on the following tree structure.



15) Consider the following five statements.

(i) It is a tree.
(ii) It is a binary tree.
(iii) It is an AVL tree.
(iv) It is a binary search tree.
(v) It is a strictly binary tree.

Which of the above statements is correct with respect to the above tree?

(a) (i) only	(b) (i) and (ii) only	(c) (i) , (ii) and (iii) only
(d) (i), (ii) and (iv) only	(e) All	

16) Consider the following four statements.

(i) Depth of the above tree is equal to 4.
(ii) C's proper descendants are I, J, K, L only.
(iii) B's siblings are C, D, E only.
(iv) K, L, M, N are siblings.

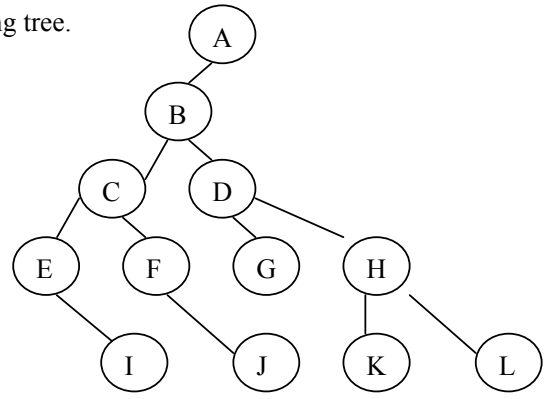
Which of the above statements is correct?

(a) (i) and (ii) only	(b) (iii) only	(c) (ii) and (iii) only
(d) (ii) only	(e) (ii), (iii) and (iv) only	

17) Which of the following are **not** hash functions?

(a) division	(b) folding	(c) coupling
(d) mid square	(e) extraction	

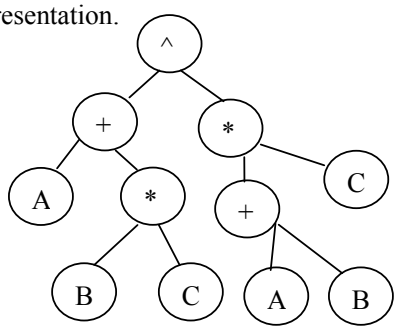
18) Consider the following tree.



Which of the following is/are correct with respect to the above tree?

(a) Pre-order listing is ABCEIFJDGHKL.	(b) Pre-order listing is ABCIEFJDGHKL.
(c) In- order listing is EICFJBGDKHLA.	(d)In- order listing is EICFJBGKDHLA.
(e) Post-order listing is IEJFCGKLHDBA.	

19) Consider the following expression tree representation.



Which of the following expressions is correct in relation to the above tree?

(a) (A*B+C)^((A+B)*C)	(b) (A+B*C)^((A+B)*C)	(c) (A+B*C)^(A+(B *C))
(d) (A+B^C)*((A+B)*C)	(e) (A+B*C)^(A+B*C)	

20) Consider the following binary search tree algorithm.

```
Public Bsnode search ( Bsnode p, int el) {

While (p!=null)
      if(el==p.key)
         return p;
     else
     if (el < p.key)
     ……(i)……..;
    else …….(ii)……;
     ……(iii)……;
   }
```

Identify suitable entries to fill in the blank positions labeled (i), (ii), (iii) of the above algorithm so that it will insert el to the binary search tree.

(a) (i) p = p.right	(ii) p =p.left;	(iii) return null;
(b) (i) p = p.left	(ii) p =p.right;	(iii) return null;
(c) (i) p = p.left.next	(ii) p =p.right.next;	(iii) return null;
(d) (i) p = p.right.next	(ii) p =p.left.next;	(iii) return null;
(e) (i) p = p.right	(ii) p =p.left;	(iii) return null;

21) Consider the following Java program segment.

```
static int ppp (  tree t)
{
if (t==null)
   return –1;
else
return 1+Math.max(ppp(t.left),ppp(t.right));
}
```

What does of the above program segment intend to do?

(a) Routine to compute the height of the node in a binary tree in a recursive way
(b) Routine to compute the height of the node in a binary tree in a non-recursive way
(c) Routine to compute the height of the node in a binary search tree in a recursive way
(d) Routine to compute the height of the node in a binary search tree in a non-recursive way
(e) Routine to compute the height of the node in an AVL tree in a non-recursive way.

22) Consider the following polynomial.

$f(n) = n^2 + 100n + Log_{10} n + 1000$

What would be the Big –O value of the above polynomial?

(a) n	(b) Log n	(c) n^2+log n
(d) n^2	(e) Constant	

23) Consider the following statement (Algorithm Segment).

The method one uses to replace the node being deleted by the rightmost node in its left sub tree or leftmost node in its right sub tree.

What does the above statement (algorithm segment) intend to do?

(a) Deleting a node from an AVL, if deleting node has both a left and a right child
(b) Deleting a node from a binary tree
(c) Deleting a node from a general tree
(d) Deleting a node from a binary search tree, if deleting node is a leaf node
(e) Deleting a node from a binary search tree, if deleting node has both a left and a right child

24) Consider the following table.

State on node	**Effect of new node**	**Action of new state**
(i) Balanced	Increase left sub tree height	Left-high
(ii) Balanced	Increase right sub tree height	Right-high
(iii)Left-high	Increase left sub tree height	Left balance
(iv)Right-high	Increase left sub tree height	Balanced
(v) Right-high	Increase right sub tree height	Left balance

Which of the above would be correct for inserting a new node into an AVL tree?

(a) (i) only	(b) (i) and (ii) only	(c) (i), (ii) and (iii) only
(d) (i) (ii) (iii) and (iv) only.	(e) (i) (iii) and (iv) only	

25) Which of the following is/are correctly describing a step in the definition of the Heap data structure?

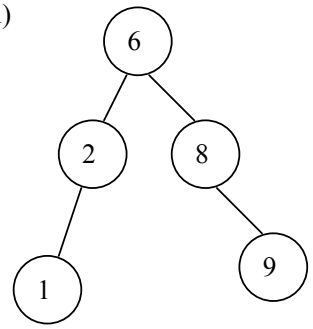
(a) All leaves are on two adjacent levels.
(b) All leaves on the lowest level occur at the left of the tree.
(c) All leaves on the lowest level occur at the right of the tree.
(d) All levels above the lowest are completely filled.
(e) Balance factor is always -1,0,+1.

26) Which of the following statements is/are correct in connection with a graph?

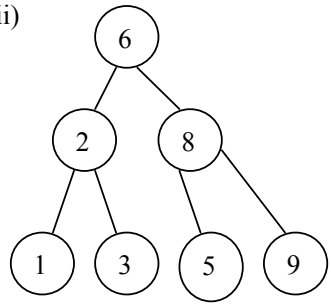
(a) Purely array-based representation of a graph is called its path matrix.
(b) Graphs may be used as diagrams which illustrate the relationship between pairs of elements in a set of objects.
(c) Depth first traversal and Breadth first traversal techniques can be used only for graphs.
(d) A multi-graph is a graph where two vertices can be joined by multiple edges.
(e) A graph is called a weighted graph if each edge has an assigned number.

27) Which of the following is/are AVL tree(s)?

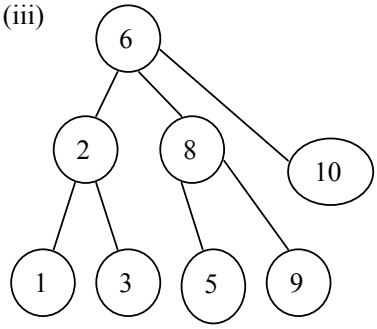
(i)



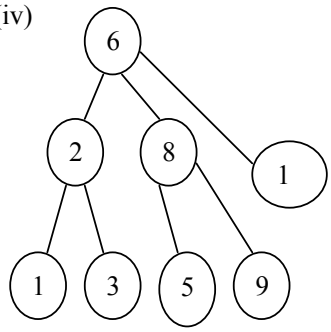
(ii)



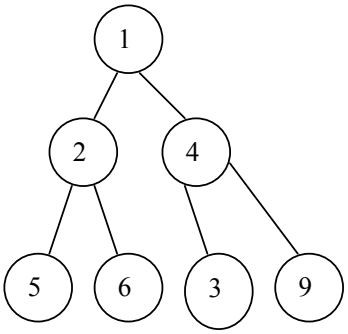
(iii)



(iv)



(v)



(a) (i) only	(b) (ii) only	(c) (iii) only
(d) (iv) only	(e) (v) only	

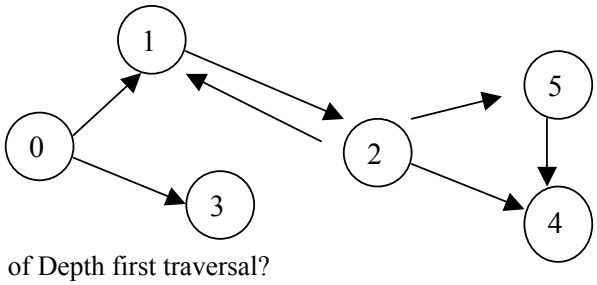
28) Consider the following pseudo code algorithm segment.

```
algo-1 ( )
  for all vertices u
     num(u)=0;
  edges=null;
  i=1;
while there is a vertex v such that num(u) = = 0
  num(v)=i++;
  enqueue(v);
 while queue is not empty
      v=dequeue();
     for all vertices u adjacent to v
      if num(u) is 0
      num(u+=i++;
     enqueue(u);
     attach edge (uv) to edges;
output edges;
```

What does the above algorithm describe?

(a) Array based implementation of queue	(b) Depth first traversal
(c) Breadth first traversal	(d) Deleting nodes from a queue
(e) Inserting nodes to a queue	

29) Consider the following directed graph.



Which of the following is/are **not** (an) output(s) of Depth first traversal?

(a) 0→1→2→4→5→3	(b) 0→1→2→5→4→3	(c) 0→3→1→2→4→5
(d) 0→1→2→2→4→3	(e) 0→1→2→5→4→1	

30) Which of the following is/are correct in connection with graph data structures?

(a) Path matrix can be defined as path [i][j] = adj[i][j] or adj_2[i][j] or adj_3i][j] or…….
(b) Transitive closure can be determined by using the path matrix.
(c) adj_3[i][j]= adj_2 [i][j]* adj[i][j] .
(d) Warshall's algorithm will increase the efficiency of finding the Transitive closure.
(e) Warshall's algorithm will increase the efficiency of finding the adjacency matrix.

31) Which of the following is/are **not** (an) alternative representation(s) of graphs?

(a) An adjacency list	(b) An adjacency matrix	(c) Depth first traversal
(d) Incidence matrix	(e) Breadth first traversal	

32) Which of the following is/are correct in connection with sorting methods?

(a) Bubble sort uses sorting by an insertion technique to sort a file of numbers.
(b) Quick sort uses sorting by an exchange technique to sort a file of numbers.
(c) Shell sort uses sorting by an exchange technique to sort a file of numbers.
(d) Heap sort uses sorting by an exchange technique to sort a file of numbers.
(e) Selection sort uses sorting by a selection technique to sort a file of numbers.

33) A set of five basic graph terms is given in **Part A** and some definitions are given in **Part B** as follows.

Part A	**Part B**
(i) Cycle	(p) A term used to schedule tasks associated with a project
(ii) Critical path Analysis	(q) In a directed graph, a path that begins and ends at the same vertex and contains at least one edge
(iii) Dijkstra's Algorithm	(r) Number of edges on the path
(iv) Path Length	(s) This solves the positive weighted shortest path problem.
(v) Graph	(t) This consists of a set of vertices and a set of edges which connect the vertices.

Choose the best definition from **Part B** for the above five terms in **Part A**

(a) (i)→(q), (ii)→(s), (iii)→(p),(iv)→(r), (v)→(t)	(b) (i)→(t), (ii)→(p), (iii)→(s),(iv)→(r), (v)→(q)
(c) (i)→(q), (ii)→(p), (iii)→(s),(iv)→(r), (v)→(t)	(d) (i)→(q), (ii)→(p), (iii)→(s),(iv)→(r), (v)→(t)
(e) (i)→(q), (ii)→(p), (iii)→(t),(iv)→(t), (v)→(s)	

Questions No. 34 and No. 35 are based on the following set of seven integers.

{2,8,13,6,7,27,18}

34) If the maximum heap is created using the above set of integers, what would be the value at the 6th position of the heap?

(a) 2	(b) 8	(c) 6
(d) 13	(e) 7	

35) If ones sorts the above heap created in Question No. 34, what would be the first and last elements respectively of the shirking array?

(a) 18,2	(b) 27,18	(c) 27,2
(d) 2,18	(e) 2, 27	

36) "Many operations can be performed faster on sorted than unsorted data". Which of the following is/are applicable to the above statement?

(a) Checking whether one word is an anagram of another word. (e.g. plum and lump)
(b) Finding an item with a minimum value
(c) Computing an average value
(d) Finding the middle value (median)
(e) Finding the value which appears most frequently (mode) in the data

Questions No. 37 and No. 38 are based on the following set of ten integers.

{50,22,11,78,16,95,7,75,51,41}.

37) If one uses the quick sort algorithm to sort the above set of integers, how many pivot values are required? You may assume that the pivot element is always selected as the last element of the respective sub arrays.

(a) 7	(b) 8	(c) 4
(d) 6	(e) 5	

38) If one uses the quick sort algorithm to sort the above set of integers, how many pivot values are required? You may assume that the pivot element is always selected as the first element of the respective sub arrays.

(a) 7	(b) 8	(c) 4
(d) 6	(e) 5	

Questions No. 39 and No. 40 are based on the following set of eight integers

{20,60,50,37,16,92,70,35}.

39) If one uses the bubble sort algorithm in ascending order, in which of the following pairs will the data values **not** interchanging during the 1st pass?

(a) 20,60	(b) 60,50	(c) 60,37
(d) 50,37	(e) 60,16	

40) How many passes are required to sort the above set of integers using the bubble sort algorithm?

(a) 6	(b) 7	(c) 8
(d) 9	(e) 5	

41) Consider the following pseudo code algorithm.

```
found = false;
 i=1;
     while (i =< n ) and  ( not found)
{
    if key=k[i]  then
     {
        search =i;
       found =true;
   else
       i++;
     }
}
 if not found
{
search=0;
}
```

What is the above algorithm intended to do?

(a) Sequential Search	(b) Depth First Algorithm
(c) Shell sort algorithm	(d) Index sequential search
(e) Breadth first search	

42) Consider the following program segment with 3 blank positions labeled (i), (ii) and (iii).

```
public static int  binarysearch( Comparable []a, comparable x } throws itemnotfound {
int low=0;
int high=a.length-1;
int mid;
while { …….(i)…… } {
mid=(low + high ) / 2 ;

if ( ……(ii)…….. )
low = mid +1;
else if ……..(iii)…….
high=mid –1
else
return mid ; }
throws new itemnotfound ( “binary search fail”); }
```

Which of the following provide correct answers for the blank positions?

(a) (i) { low <> high } (ii) a[mid].compares(x) < 0 (iii) a[mid].compares(x) > 0
(b) (i) { low <= high } (ii) a[mid].compares(x) =< 0 (iii) a[mid].compares(x) > 0
(c) (i) { low <= high } (ii) a[mid].compares(x) < 0 (iii) a[mid].compares(x) >= 0
(d) (i) { low <= high } (ii) a[mid].compares(x) < 0 (iii) a[mid].compares(x) > 0
(e) (i) { low <= high } (ii) a[high].compares(x) < 0 (iii) a[mid].compares(x) > 0

43) Consider the following four terms given in **Part A** and some definitions given in **Part B**.

Part A	**Part B**
(i) Big O	(p) The notation used to capture the most dominant term in a function
(ii) Big Omega	(q) A guarantee over all inputs of some size
(iii) Average case bound	(r) The bound in which running time is measured as an average over all the possible inputs of size N
(iv) Worst case bound	(s) An algorithm that causes the running time to grow as O(N)
(v) Linear time algorithm	(t) The notation similar to greater than or equal to when considering growth rates

Choose the best definition from **Part B** for the above five hash operations respectively in **Part A**.

(a) (i)→(p) (ii)→(r) (iii)→(t) (iv)→(q) (v)→(s)	(b) (i)→(s) (ii)→(t) (iii)→(r) (iv)→(q) (v)→(p)
(c) (i)→(p) (ii)→(t) (iii)→(r) (iv)→(q) (v)→(s)	(d) (i)→(p) (ii)→(s) (iii)→(r) (iv)→(q) (v)→(t)
(e) (i)→(p) (ii)→(t) (iii)→(r) (iv)→(s) (v)→(q)	

44) Consider the following bubble sort algorithm.

```
public void bubblesort (object [] data ){
   int i,j;
   for (i= 0; i < data.length-1; i++)
        for ( j = data.length-1; j > i ;--j)
          if ( ((Comparable)data[j]).compareTo (data[j-1]) < 0)
          swap ( data,j,j-1);
}
```

What would be the best, average and worst-case time complexities of the above algorithm respectively?

(a) n , n , n^2	(b) n^2 , log n, n^2	(c) n , n^2 , n^2
(d) n , log n, n^2	(e) n^2 , n^2 , n^2	

45) Consider the five operations in **Part A** and some definitions in **Part B** as follows.

Part A	**Part B**
(i) Void clear( )	(p) Return true if the hash table contains the object val; raise NullPointerException if val is null.
(ii) Object clone ( )	(q) Return true if the hash table contains the object key; raise NullPointerException if key is null.
(iii) Boolean contains(val)	(r) Return true if the hash table contains the object val ; NullPointerException if val is null.
(iv) Boolean containsKey(key)	(s) Return the copy of the hash function without cloning its elements
(v) Boolean containsvalue(val)	(t) Remove all the objects from the hash table.

Choose the best definition from **Part B** for the above five terms in **Part A**.

(a) (i)→(r), (ii)→(s), (iii)→(p), (iv)→(q), (v)→(t)
(b) (i)→(p), (ii)→(s), (iii)→(t), (iv)→(q), (v)→(r)
(c) (i)→(t), (ii)→(p), (iii)→(s), (iv)→(q), (v)→(r)
(d) (i)→(t), (ii)→(s), (iii)→(p), (iv)→(q), (v)→(r)
(e) (i)→(t), (ii)→(s), (iii)→(q), (iv)→(p), (v)→(r)

*****