

Second Semester - Question Bank  
 Department of Computer Science  
 Advanced Data Structures and Algorithms

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**Q1)** Let the keys are 28, 47, 20, 36, 43, 23, 25, 54 and table size is 11 then

$H(28)=28\%11=6$ ;  $H(47)=47\%11=3$ ;  $H(20)=20\%11=9$ ;  $H(36)=36\%11=3$ ;  
 $H(43)=43\%11=10$ ;  $H(23)=23\%11=1$ ;  $H(25)=25\%11=3$ ;  $H(54)=54\%11=10$ .

What is the hash address of above keys???

.....

**Q2)** Suppose we have a set of strings {"abc", "def", "ghi"} that we'd like to store in a table.

Suppose we assign "a" = 1, "b"=2, ... etc to all alphabetical characters. We can then simply compute a number for each of the strings by using the sum of the characters as follows. "abc" = 1 + 2 + 3=6, "def" = 4 + 5 + 6=15 , "ghi" = 7 + 8 + 9=24

If we assume that we have a table of size 5 to store these strings, we can compute the location of the string by taking the sum mod 5.

What is the hash address of above keys???

.....

**Q3)** Consider inserting the following keys into a hash table of length  $m = 10$ :

2 4 1 20 15 31 14 3 0 11

The auxiliary hash function is given by  $(k \text{ mod } m)$ . Draw the resulting hash table if we use chaining for collision resolution.

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**Q4)** What are the correct intermediate steps of the following data set when it is being sorted with the Quicksort?

38	81	22	48	13	69	93	14	45	58	79	72
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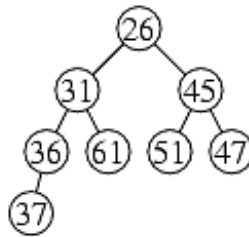
Pivot element (69).

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Q5) What are the correct intermediate steps of the following data set when it is being sorted with the Quicksort?

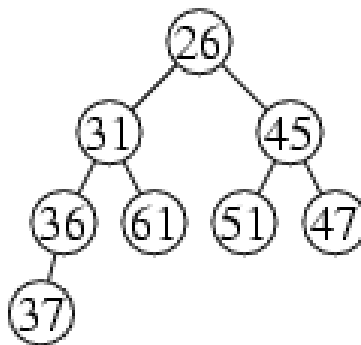
.....

Q6) suppose we insert **20** into the heap whose tree diagram is below. What will its tree diagram then be?



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Q7) suppose we remove the *minimum* **twice** from the heap whose tree diagram is below. What will its tree diagram then be?

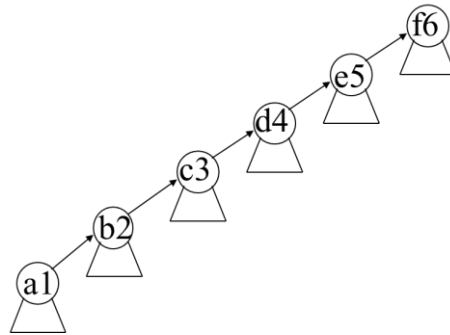


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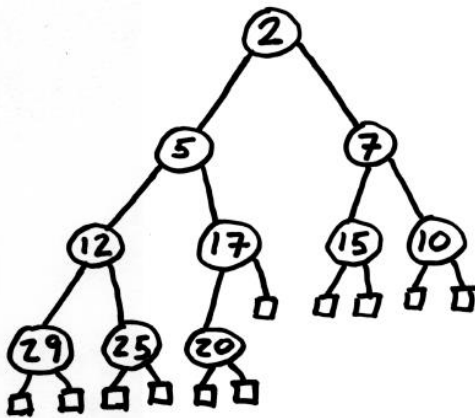
Q8) A list of unsorted elements are: **39 9 81 45 90 27 72 18** use divide algorithm to divide the elements.

.....  
 Q9) Suppose we have the following list of characters **BAABABBBBAABBBAA**, use Lempel Ziv encoding algorithm to compress the above uncompressed characters after that use the same algorithm for decoding. (3 marks)

.....  
 Q10) Suppose we have the figure below use path compression algorithm of FIND-SET (c3) operations to achieve the main steps of the algorithm.



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 Q11) Consider the heap given below.



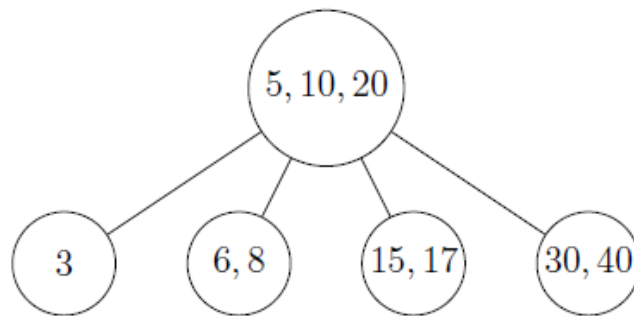
First perform two DeleteMin operations on this heap. Then insert the element 14 into the heap. Finally perform one more DeleteMin operation. As above, draw the heap after each step and give the final vector representation after all the operations have been performed.

.....  
Q12) Insert the items into a heap (that is initially empty) in the order given below:

12; 6; 20; 11; 7; 9; 15; 10; 3

Draw the heap after each insertion. Give a vector representation of the heap after the last item has been inserted.

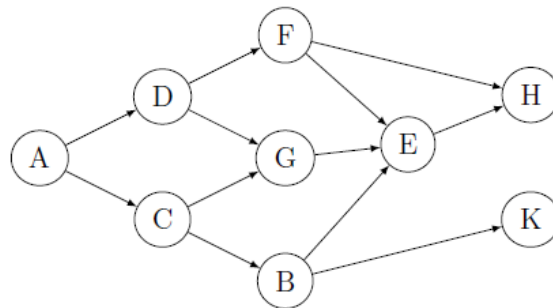
.....  
Q13 ) 2-3-4 Trees. Consider the following 2-3-4 tree.



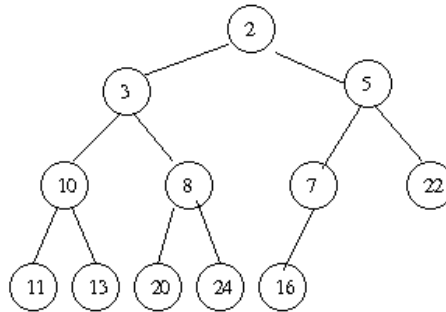
a) Draw the modified tree resulting in inserting 18, using the top-down approach.

b) Now insert 14 into the tree from the previous step.

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Q14) Give 6 possible DFS traversals of the graph below, listing the nodes in the order they are discovered. A should be the starting vertex.



Q15) Show how the min heap below would be implemented in an array.

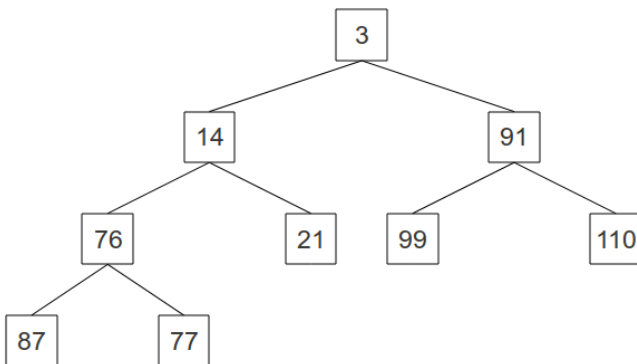


Q16) The array A below represents a binary heap implementation of a priority queue of items. Only the integer key values of the items are shown. The priority queue is arranged with the lowest-value key first.

	0	1	2	3	4	5	6	7	8	9
A		3	14	91	76	21	99	110	87	77

Draw the binary heap structure (tree) represented by A.

Q17) Below is the binary heap structure from Question 16:



Draw the heap structure after the lowest-key item has been removed.

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Q18) Draw the heap structure after a new item with key 1 has been added for question 16.

.....

Q19) Suppose we have the following array representing a heap as seen in class (where lower numbers represent higher-priority elements). What will the array contain following an insertion of the number 4 into the heap?

1	5	2	6	7	3	9	10	8	
---	---	---	---	---	---	---	----	---	--

.....

Q20) Suppose we have a heap of integers stored in an array as follows. What would the array contain after a single `remove` operation?

1	2	5	3	4	7	8	9	6
---	---	---	---	---	---	---	---	---

.....

Q21) use run-length encoding to encode the following array .

a	a	a	a	a	a	a	a	b	b	b	b	b	b	c	c
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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.....

Q22) use run-length encoding to encode the following string .

The string: "aaaabbcdeeeefghhhij"

.....

Q23) use run-length encoding to encode the following string .

The string: "aooaaabybcdllllfgwwwvvvqqq"

**Q24).** Draw a picture of the directed graph specified below:

$G = (V, E)$

$V(G) = \{1, 2, 3, 4, 5, 6\}$

$E(G) = \{(1,2), (2, 3), (3, 4), (5,1), (5, 6), (2, 6), (1, 6), (4, 6), (2, 4)\}$

Obtain the following for the above graph:

(i) Adjacency matrix.

(ii) path matrix.

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Q25) Multiple Choice Questions:

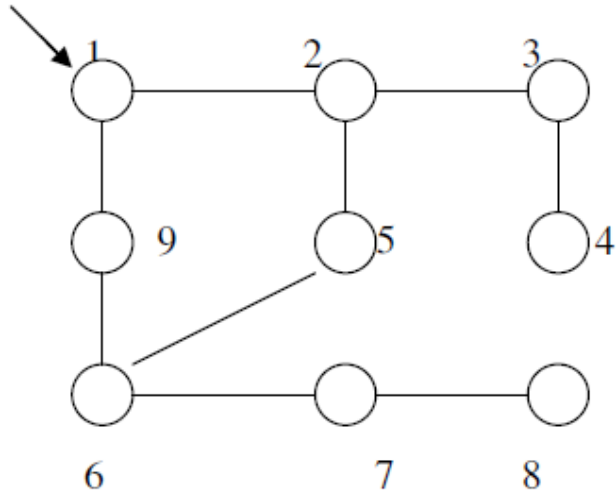
1. If  $h$  is any hashing function and is used to hash  $n$  keys in to a table of size  $m$ , where  $n \leq m$ , the expected number of collisions involving a particular key  $x$  is :  
(A) less than 1. (B) less than  $n$ .  
(C) less than  $m$ . (D) less than  $n/2$ .
2. Let  $A$  be an adjacency matrix of a graph  $G$ . The  $ij^{\text{th}}$  entry in the matrix  $A^K$ , gives  
(A) The number of paths of length  $K$  from vertex  $V_i$  to vertex  $V_j$ .  
(B) Shortest path of  $K$  edges from vertex  $V_i$  to vertex  $V_j$ .  
(C) Length of a Eulerian path from vertex  $V_i$  to vertex  $V_j$ .  
(D) Length of a Hamiltonian cycle from vertex  $V_i$  to vertex  $V_j$ .
3. You have to sort a list  $L$  consisting of a sorted list followed by a few "random" elements. Which of the following sorting methods would be especially suitable for such a task?  
(A) Merge sort (B) Selection sort  
(C) Quick sort (D) Insertion sort
4. A technique for direct search is  
(A) Binary Search (B) Linear Search  
(C) Tree Search (D) Hashing
5. If a node having two children is deleted from a binary tree, it is replaced by its  
(A) Inorder predecessor (B) Inorder successor  
(C) Preorder predecessor (D) None of the above
6. The postfix form of the expression  $(A + B) * (C * D - E) * F / G$  is

- (A)  $AB + CD * E - FG /**$     (B)  $AB + CD * E - F **G /$   
 (C)  $AB + CD * E - *F *G /$     (D)  $AB + CDE * - * F *G /$
7. What is the postfix form of the following prefix expression  $-A/B*C\$DE$   
 (A)  $ABCDE\$*/-$     (B)  $A-BCDE\$*/-$   
 (C)  $ABC\$ED*/-$     (D)  $A-BCDE\$*/$
8. A sort which relatively passes through a list to exchange the first element with any element less than it and then repeats with a new first element is called  
 (A) insertion sort.    (B) selection sort.  
 (C) heap sort.    (D) quick sort.
9. The number of different directed trees with 3 nodes are  
 (A) 2    (B) 3  
 (C) 4    (D) 5
10. The postfix form of  $A*B+C/D$  is  
 (A)  $*AB/CD+$     (B)  $AB*CD/+$   
 (C)  $A*BC+/D$     (D)  $ABCD+/*$
11. A binary tree of depth “d” is an almost complete binary tree if  
 (A) Each leaf in the tree is either at level “d” or at level “d-1”  
 (B) For any node “n” in the tree with a right descendent at level “d” all the left descendents of “n” that are leaves, are also at level “d”  
 (C) Both (A) & (B)  
 (D) None of the above

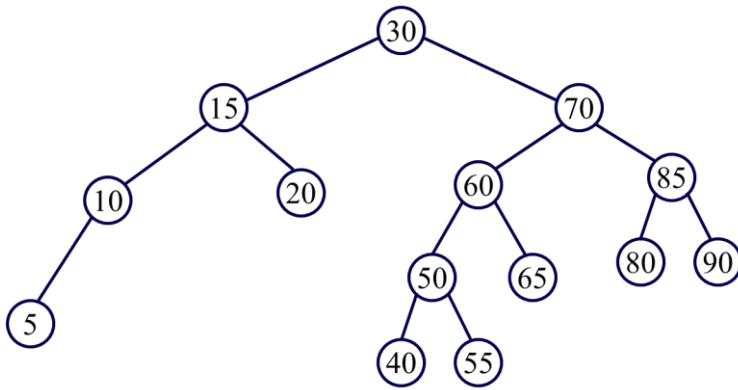
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Q26) Suppose we have the following graph use the figure below to visit the vertices of the graph under both DFS and BFS.





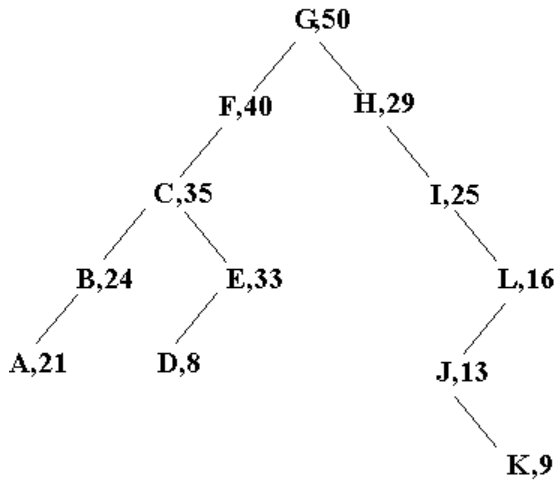
Q27) Do a single rotation suppose that 60 is your pivot node.



Q28) Suppose we have the following example of treap, draw a tree .

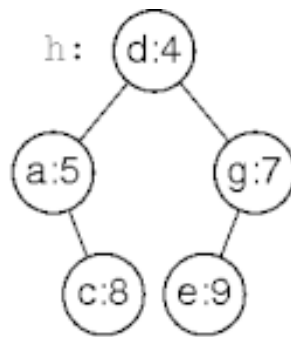
key	a	b	c	d	e	f	g
priority	3	7	4	1	5	2	6

Q29) Delete the key **C** from this treap suppose that we have a maxheap (the value of root will be greater):



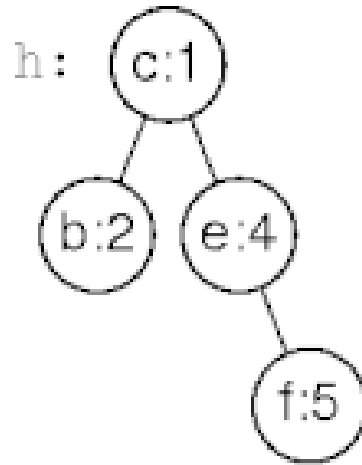
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Q30) Insertion in the **treap the node (f:6)**



.....

Q31) Delete in the **treap the node (c)**



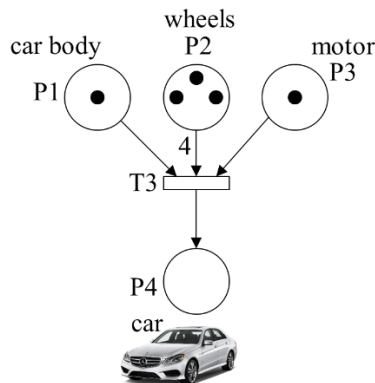
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Q32) build a treap using all the English aplanatic a,b,c ...x,y,z. as following :

**t:1; h:2;z:6 ;d:5;o:23;x:27;a:19;f:12 ;k:37 ;p:30 ;v: 47;y:32 ;c:28 ;e: 42;g:31 ;j: 62;l: 53;q:36 ;u: 77;w:49;b: 56;i:73 ;n:55 ;s: 46;m: 76;r:72 .**

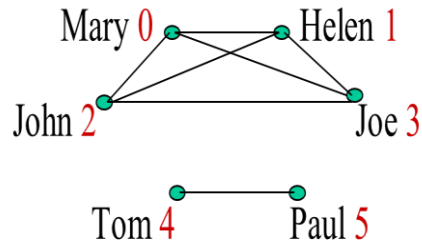
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Q33) Suppose we have the following Petri Net model, explain the Transition enabling concept after T3 firing.

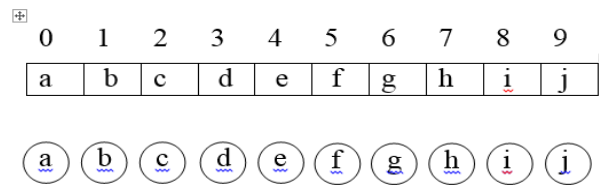


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Q34) Suppose we have the following graph explain Adjacency Matrix and Linked list.



Q35) Consider the following disjoint set on the ten characters:



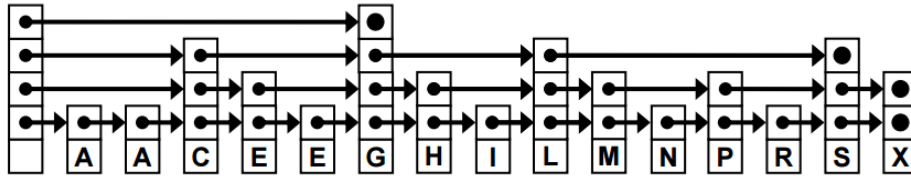
{a}, {b}, {c}, {d}, {e}, {f}, {g}, {h}, {i}, {j}

Use *Find(x)* and *Union(x, y)* functions of disjoint-set algorithm to perform the following tasks:

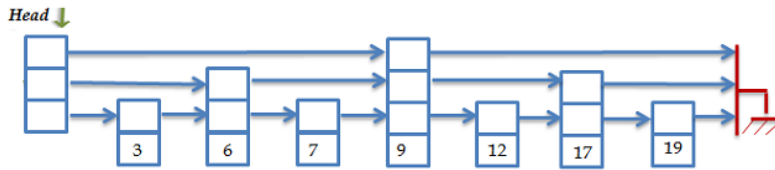
1. set\_union(1, 3);
2. set\_union(3, 5);
3. set\_union(5, 7);
4. set\_union(6, 8);
5. set\_union(8, 9);
6. set\_union(4, 8);
7. set\_union(5, 6);

Q36) Write the algorithm of Disjoint-Sets

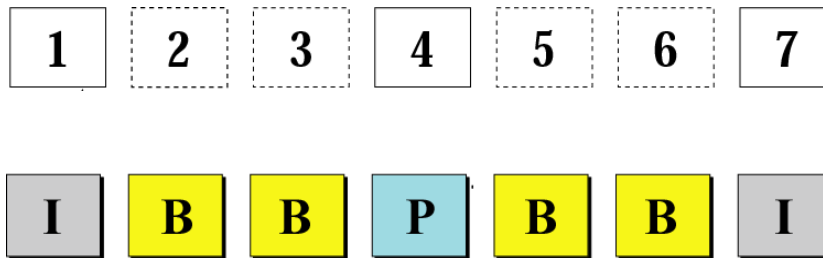
Q37) suppose we have the following Skip list try to find R.



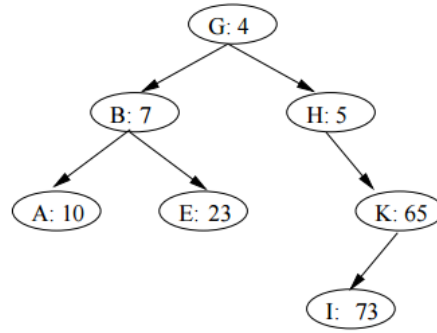
Q38) Imagine we have multi-level list as The next figure shows an example of a skip list. consider we want to find “7” in the example above.



Q39) suppose we have the following MPEG frame construction use the concept of MPEG method with I-frames, P-frames, B-frames to show the relation of frames.



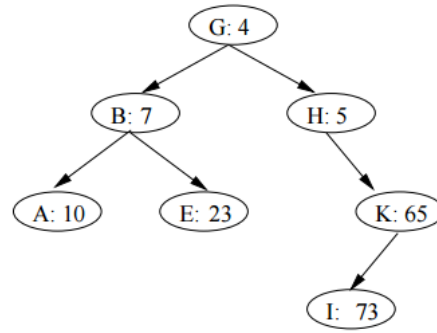
Q40) (a) Original treap prior to insertion. (b) The treap after inserting a node with key C and priority 25. (c)–(d) Intermediate stages when inserting a node with key D and priority 9. (e) The treap after insertion of parts (c) and (d) is done. (f) The treap after inserting a node with key F and priority 2.



(a)

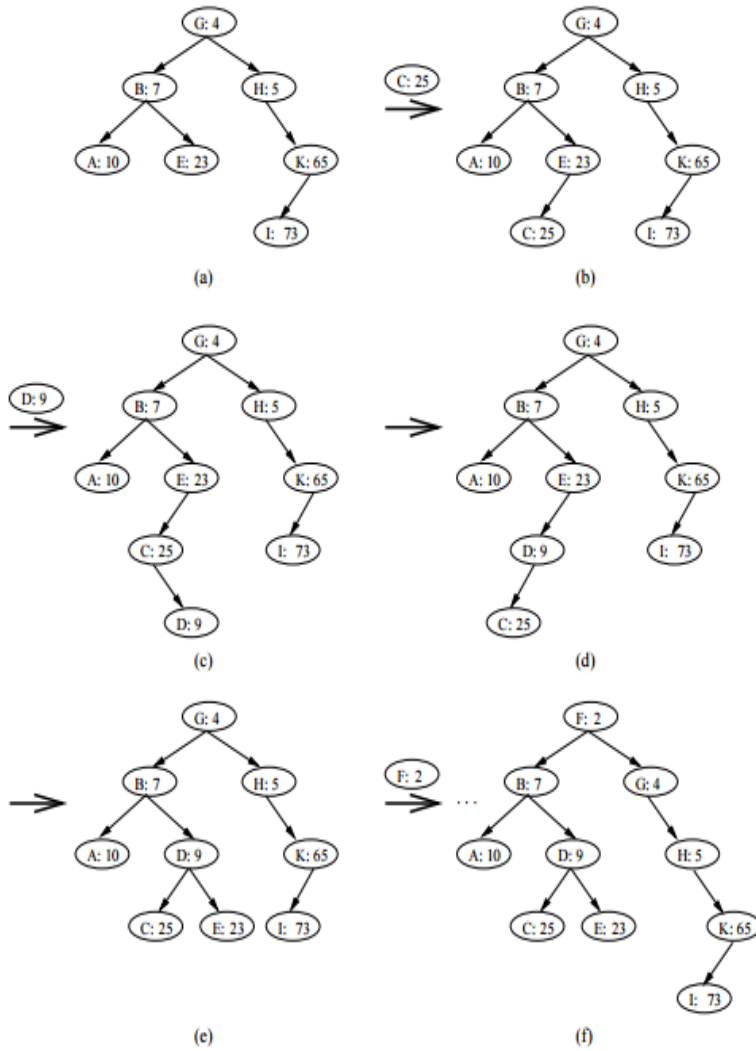
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**Q40** (a) Original treap prior to insertion. (b) The treap after inserting a node with key C and priority 25. (c)–(d) Intermediate stages when inserting a node with key D and priority 9. (e) The treap after insertion of parts (c) and (d) is done. (f) The treap after inserting a node with key F and priority 2.



(a)

.....solve.....



Q41) Explain Zig Zag Sequence with example and show the final result of reading it.

..... solve .....

$T(m,n)$

20	15	12	0	0	0	0	0
15	17	0	0	0	0	0	0
12	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

↓

20	15	15	12	17	12	0	0	0	0	0	0	0	0	0
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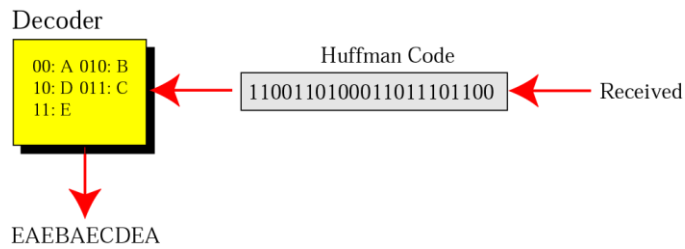
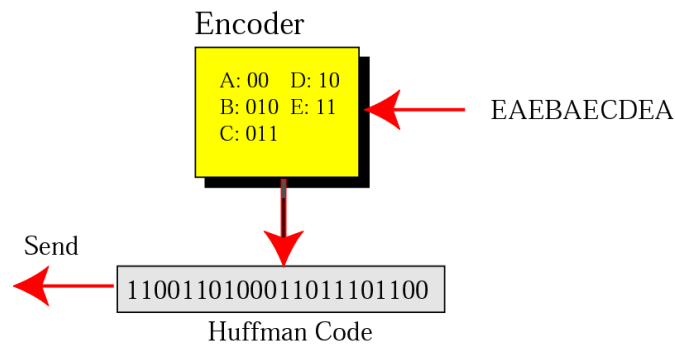
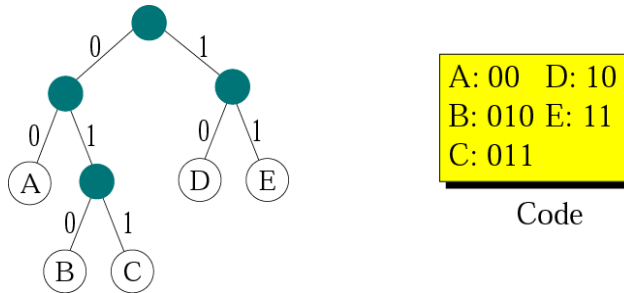
Result

Q42) suppose we have the following Frequency of characters of Huffman coding

Character	A	B	C	D	E
Frequency	17	12	12	27	32

Explain the encoding and decoding for the above characters.

..... solve.....



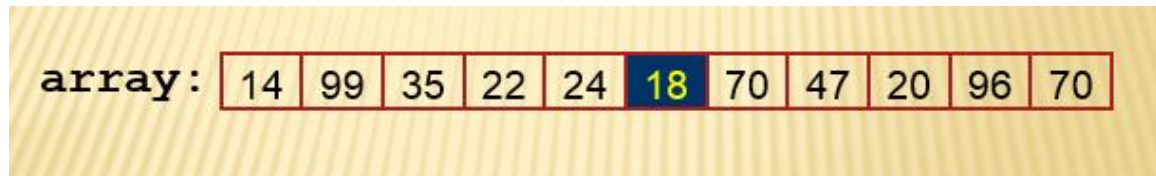
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Q43) Suppose we have the following ArrayList to hold the data of a **Heap** draw a tree and insert node 58 and after that delete on node 39.

0	1	2	3	4	5	6	7	8	9	10	11	12
8	18	29	20	28	39	66	37	26	76	32	74	89



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Q44) What are the correct intermediate steps of the following data set when it is being sorted with the Quicksort?



.....  
Q45) What are the correct intermediate steps of the following data set when it is being sorted with the Quicksort?



.....  
Q46) What are the correct intermediate steps of the following data set when it is being sorted with the Quicksort?



.....  
Q47)

1. Explain briefly about BFS,
2. Explain briefly about DFS,
3. Explain briefly about recursive DFS.

.....  
Q48) Consider an array: {25, 14, 16, 13, 10, 8, 12} represents a binary heap. What is the content of the array after two delete operations on a binary heap?

.....  
Q49) The Keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function  $H(K) = \text{mod } 10$  and linear probing. What is the resultant hash table?

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Q50) The elements 32, 15, 20, 30, 12, 25 and 16 are inserted one by one in the given order into a Max-heap. What is the resultant heap?

.....  
Q51) Consider an undirected graph with vertex set  $V = \{ n_1, n_2, n_3, n_4, n_5, n_6, n_7, n_8 \}$  and edge set  $E = \{ (n_1, n_2), (n_1, n_3), (n_1, n_4), (n_1, n_7), (n_2, n_3), (n_2, n_4), (n_2, n_5), (n_3, n_5), (n_3, n_6), (n_3, n_7), (n_4, n_5), (n_4, n_7), (n_5, n_6), (n_5, n_7), (n_5, n_8), (n_6, n_8), (n_7, n_8) \}$ . Draw the undirected graph.

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Q52) Write down the divide and conquer technique for multiplying two matrices.

.....  
Q53) What is 2-3 tree? How is it better than other search trees? Construct a 2-3 tree for the list C, O, M, P, U, T, I, N, G.

.....  
Q54) ) What do you mean by hashing? Why do we need it?

.....  
Q55) Construct binary search tree for the data 8, 10, 3, 2, 1, 5, 4, 6, and 11. Insert an element 7 into binary search tree.

.....  
Q56) Explain the following::

1. What are the properties of binary search trees?
2. Explain expression trees.
3. How are trees differing from graphs?

.....  
Q57) Differentiate between DFS and BFS

Q58) Draw a binary search tree corresponding to the input 25, 60, 71,19,30,40,9,10, 25,65, 81. What will be the resultant tree after the deletion of the element '60'?

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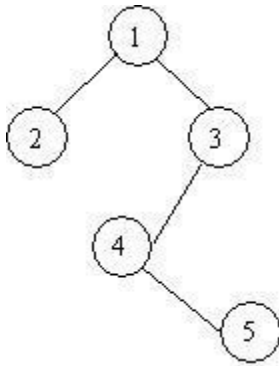
Q58) How many null nodes will a binary tree with 20 nodes have? And give me example

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Q59) How many different trees are possible with 3 nodes? Consider a tree with 3 nodes (n=3), draw the trees.

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Q60) In the given binary tree, using array you can store the node 4 at which location?



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