ALGORITHMS

SOLUTIONS

1. Which of the following is/are True?

(i) An almost complete Binary Tree in a minheap tree if every parent node is minimum compared with its children.

(ii) An almost complete Binary tree is a minheap tree if every parent node is greater than its left child and less than or equal to its right child.

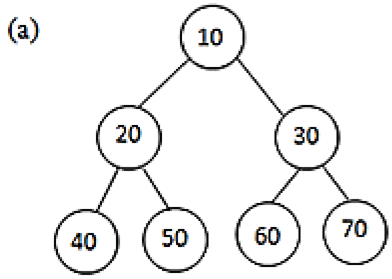
(iii) Heap sort is an inplace sorting technique

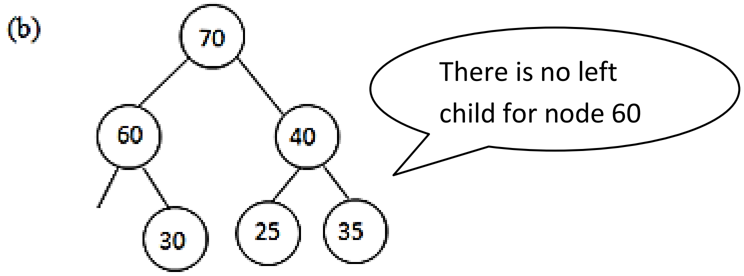
(iv) Heap sort is stable.

(a) Only (ii), (iii) & (iv)
(b) Only (i), (iii) & (iv)
(c) Only (i) & (iii)
(d) Only (ii) & (iv)

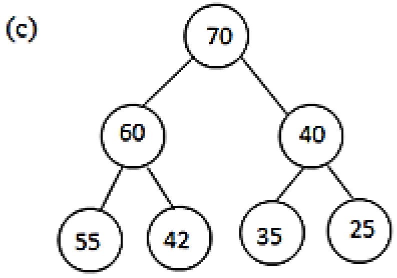
Solution: Option (c)

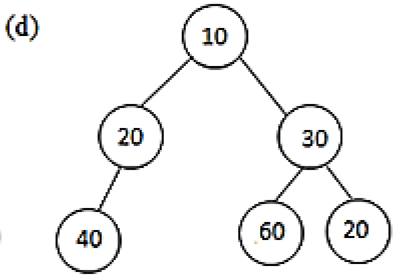
2. Which of the following is an almost complete binary tree as well as a max heap?





There is no left child for node 60





Solution: Option (c)

Explanation:
Properties of ACBT:

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--First fill left node, then right
--First fill present level, then goto next level

<u>Properties of Maxheap:</u>
--An ACBT is maxheap if every parent node is greater than or equal to its child nodes.

(a) is an almost complete binary tree and it satisfies property.
ACBT – (i) first fill left node, then right
(ii) first fill present level, then goto next level).

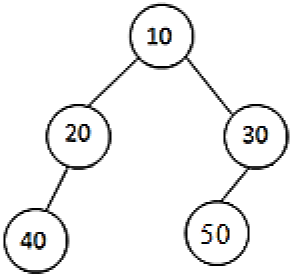
(b) is not an almost complete binary tree.

(c) is ACBT and satisfies maxheap property (i.e., every parent node is greater than or equal to both of its children).

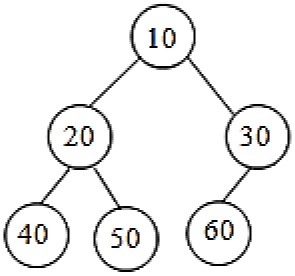
(d) is neither an ACBT nor a max heap.

3. Which of the following binary tree is an almost complete binary tree but not a complete binary tree?

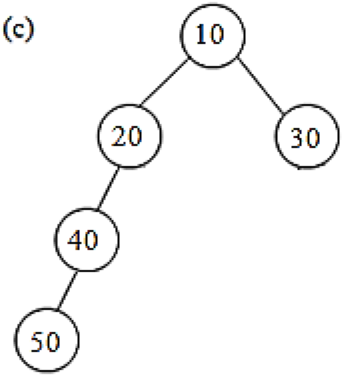
(a)



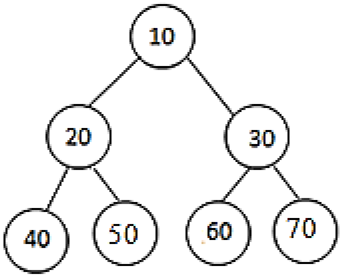
(b)



(c)



(d)



Solution: Option (d)

Explanation:

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In an almost complete binary tree, if last level is completely filled then it is called a complete binary tree.

(a) is not an ACBT
(b) is an ACBT but not complete
(c) not an ACBT
(d) is ACBT as well as complete

4. Worst case time complexity of heap sort is

(a) O(n^2)
(b) O(n log n)
(c) O(log n)
(d) O(n^3)

Solution: Option (b)

5. Which of the following data structures is best suited for heap sort?

(a) Array
(b) Singly linked list
(c) doubly linked list
(d) double ended queue

Solution: Option (a)

Explanation:
Since a binary heap is an almost complete binary tree, it can be easily represented as an array and array based representation is space efficient. If the parent node is stored at index i, the left child can be found at index 2i + 1 and right child at index 2i + 2.

6. Which of the following is True about heap data structure?

(i) Priority queues can be efficiently implemented using Binary heap.
(ii) Heap data structure can be used to efficiently find the kth smallest (or largest) element in an array.

(a) Only (i)
(b) Only (ii)
(c) Both (i) & (ii)
(d) Neither (i) nor (ii)

Solution: Option (c)

Explanation:

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(i) Priority queues can be efficiently implemented using Binary heap because it supports insert( ), delete( ), extractmax( ), decreasekey( ) in O(log n) time.

(ii) Order statistics: Heap data structure can be used to efficiently find kth smallest (or largest) element in an array.

Method for getting kth largest:

(a) Build Max heap → O(n)

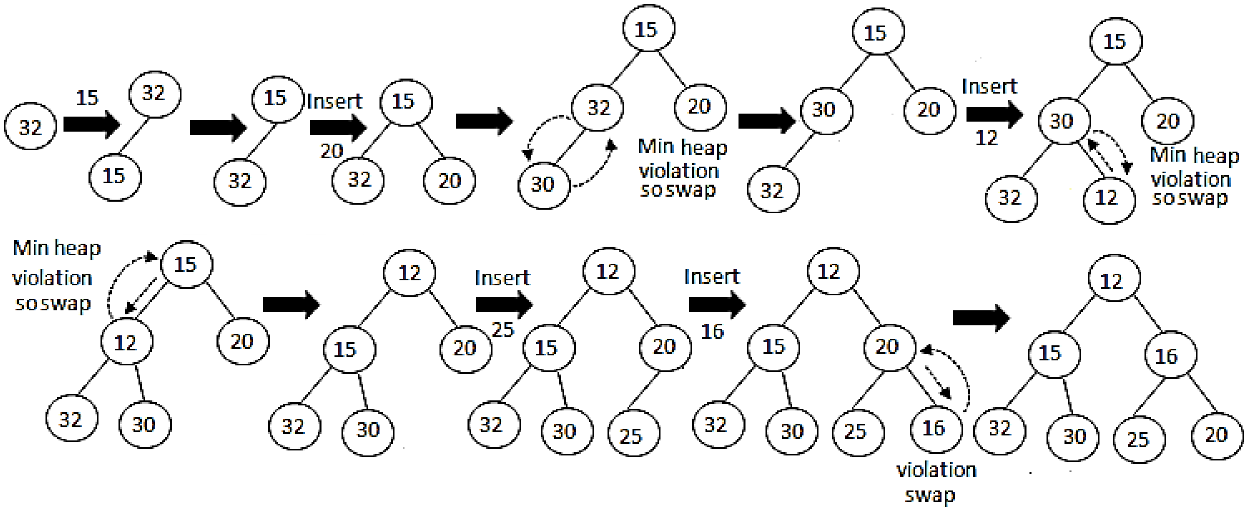
(b) Use Extract max( ) k times to get k max elements from the max heap → O(k log n)

Time complexity: O(n + k log n)

7. The pre-order and post order traversal of a binary min heap constructed by inserting 32, 15, 20, 30, 12, 25, 16 into an empty min heap:

(a) Preorder: 32, 15, 12, 30, 16, 20, 25; Postorder: 32, 12, 15, 20, 25, 16, 30.
(b) Preorder: 12, 15, 32, 30, 20, 25, 16; Postorder: 32, 12, 25, 15, 20, 16, 30
(c) Preorder: 12, 15, 32, 30, 16, 25, 20; Postorder: 32, 30, 15, 25, 20, 16, 12
(d) Preorder: 32, 15, 12, 30, 20, 25, 16; Postorder: 32, 30, 25, 15, 20, 16, 12
Solution: Option (c)

Explanation:



Preorder: 12, 15, 32, 30, 16, 25, 20.

Postorder: 32, 30, 15, 25, 20, 16, 12.

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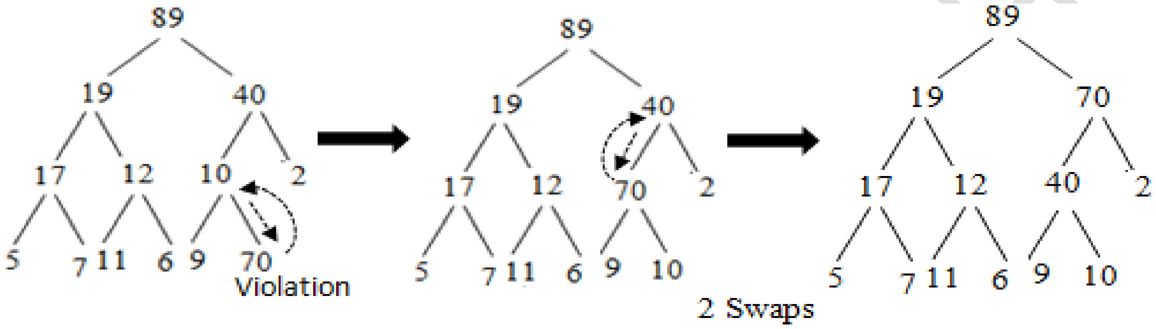
8. The minimum number of interchanges needed to convert the array: 89, 19, 40, 17, 12, 10, 2, 5, 7, 11, 6, 9, 70 into maxheap.

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

Solution: Option (c)

Explanation:



9. How much time it takes to insert an element into a max heap or min heap, which already contain n elements?

(a) Best: Ω(log n), Worst: O(log n)
(b)Best: Ω(1), Worst: O(log n)
(c) Best: Ω(log n), Worst: O(n)
(d) Best: Ω(1), Worst: O(n)

Solution: Option (b)

10. Which of the following is/are True about Greedy approach?

(i) A greedy algorithm always makes the choice that looks best at the movement.
(ii) Greedy algorithms always yield optimal solution.
(iii) Dijkstra's algorithm for shortest paths from a single source is one of the applications of Greedy approach.

(a) Only (i) & (ii)
(b) Only (i) & (iii)
(c) Only (ii) & (iii)
(d) All are true

Solution: Option (b)

Explanation:

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(i) A Greedy algorithm always makes the choice that looks best at the movement. That is, it makes a locally optimal choice in the hope that this choice will lead to a globally optimal solution.

(ii) Because of this reason specified in (i), Greedy approach do not always yield optimal solution, but for many problems they do.

(iii) Dijkstra’s algorithm is one of the applications of Greedy approach.

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