Aayush Shah
19BCE245
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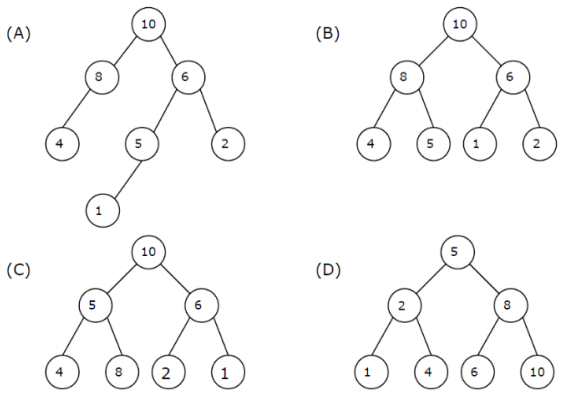
Design and Analysis of Algorithms

Tutorial 5

1. **What is the time complexity of Build Heap operation. Build Heap is used to build a max(or min) binary heap from a given array. Build Heap is used in Heap Sort as a first step for sorting.**
   A. O(nLog n)
   B. $O(n^2)$
   C. O(Log n)
   D. O(n)

2. **Suppose we are sorting an array of eight integers using heapsort, and we have just finish ed some heapify (either maxheapify or minheapify) operations. The array now looks like this: 16 14 15 10 12 27 28 How many heapify operations have been performed on root of heap?**
   A. 1
   B. 2
   C. 3 or 4
   D. 5 or 6

3. **A max-heap is a heap where the value of each parent is greater than or equal to the values of its children. Which of the following is a max-heap?**



A. A

B. B

C. C

D. D

4. **WIn a binary max heap containing n numbers, the smallest element can be found in time. Is an array of a sorted elements producing a min heap tree? Justify with an example.**

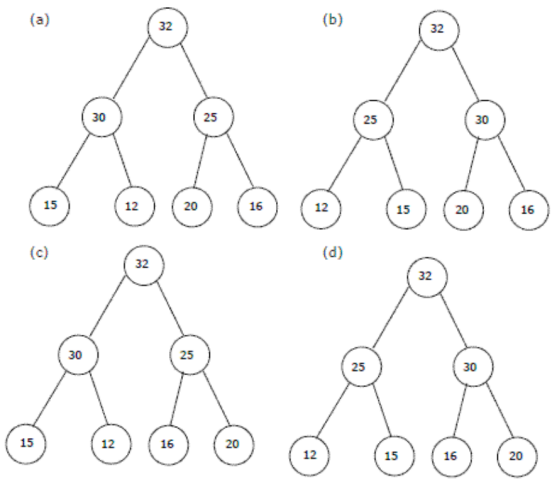
A. O(n)

B. O(Log n)

C. O(Log Log n)

D. O(1)

5. **The elements 32, 15, 20, 30, 12, 25, 16 are inserted one by one in the given order into a Max heap. the resultant max heap is :**



A. a

B. b

C. c

D. d

6. **A priority queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is: 10, 8, 5, 3, 2. Two new elements 1 and 7 are inserted into the heap in that order. The level-order traversal of the heap after the insertion of the elements is:**

A. 10,8,7,3,2,1,5

B. 10,8,7,2,3,1,5

C. 10,8,7,1,2,3,5

D. 10,8,7,5,3,2,1

- **Answer the following question :**

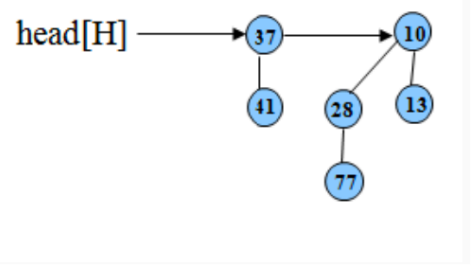
1. **Explain the terms Binary Heap and Binomial heap**

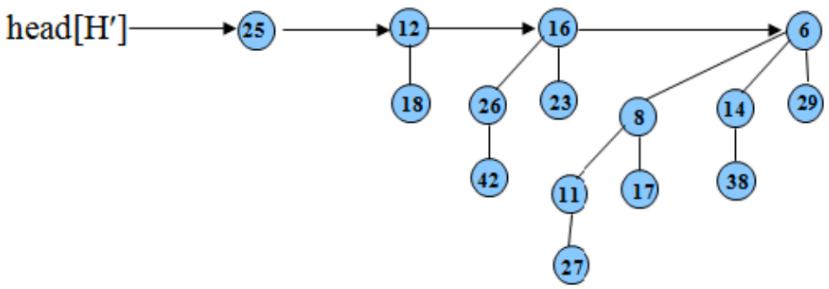
The properties of a Binary Heap are as follows.

- It is a fully grown tree (All levels are completely filled except possibly the last level and the last level has all keys as left as possible). Binary Heaps can be stored in an array because of this property.
- A Binary Heap can be either Min or Max. The key at the root of a Min Binary Heap must be the smallest of all the keys in the heap. For all nodes in the Binary Tree, the same property must be true recursively. MinHeap and Max Binary Heap are similar.

The structure of the heaps is the main difference between a binary and a binomial heap. The heap in a binary heap is a single tree that is a complete binary tree. The heap in a binomial heap is made up of smaller trees (a forest of trees), each of which is a binomial tree. A complete binary tree can hold any number of elements, but in a binomial tree of some order n, the number of elements is always 2n. As a result, a binary heap only requires one complete binary tree, whereas a binomial heap may require many binomial trees. The binomial trees employed in a binomial heap have orders that correspond to the 1 bits set in the binary representation of the number of items in the forest.

2. **Explain the terms Binary Heap and Binomial heap**





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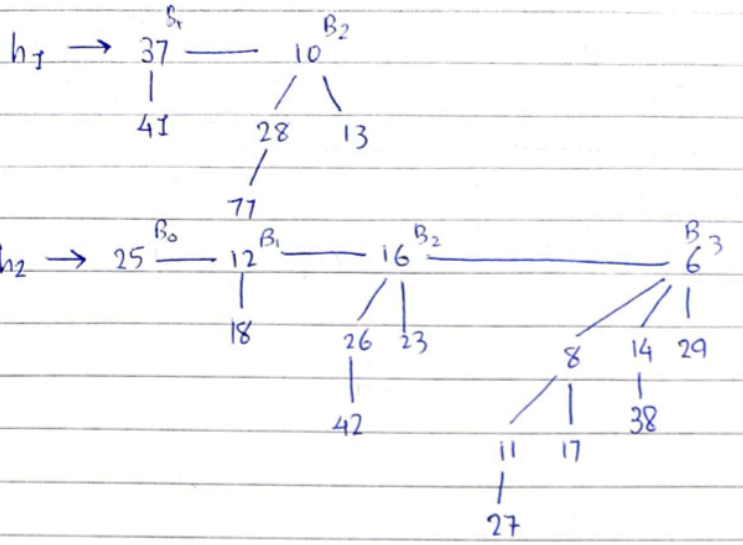
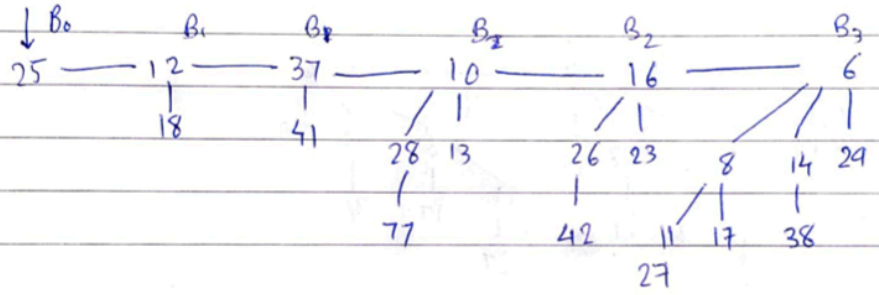
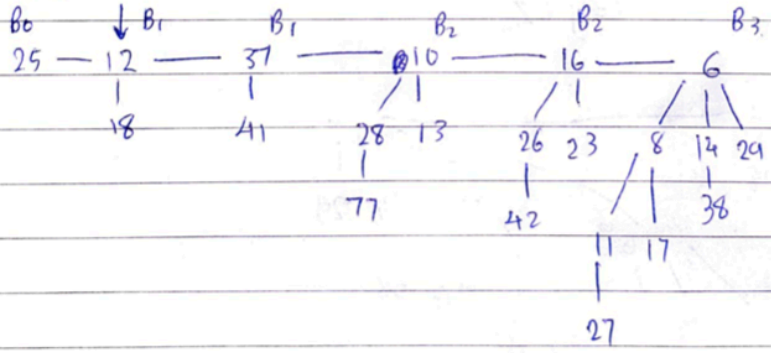
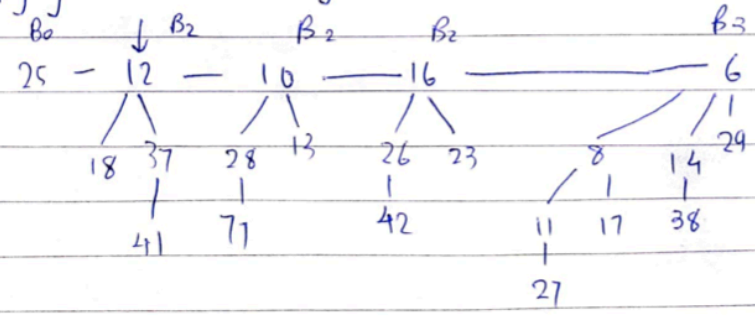




▷ Applying case 1 : $X \neq Y$



Applying case 3 : $x = y \neq z$



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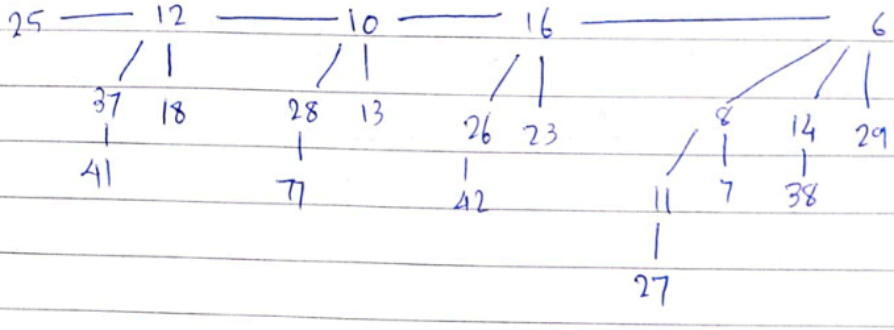
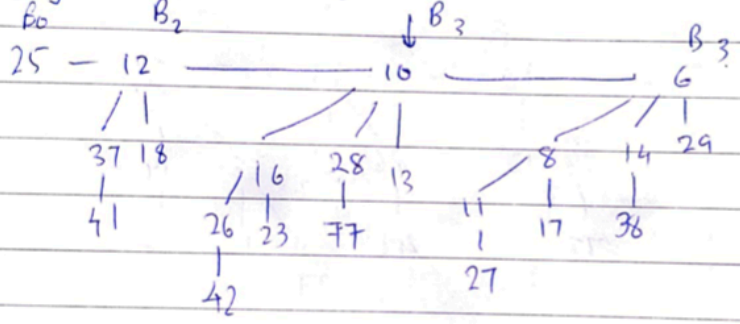
Applying case 2: $x = y = z$



Applying case 3: $x = y \neq z$.



Applying Case 3: $x = y \neq z$.