Practice Set 2

Course - Data Structures
Topics - Heaps, Hashing, 2-3 Trees & BSTs

Heaps

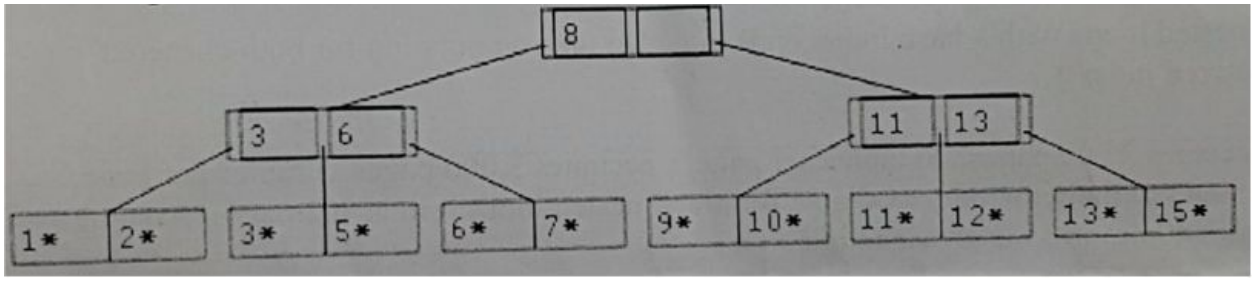
Q1. There are two arrays, A and B. Find out the top k elements (max elements) formed by combination of A and B (A[i] + B[j]).
Q2. Find the k maximum elements in an array, using max heap.
Q3. Suppose you are given a max heap with distinct elements, where can the minimum element reside in the heap?
Q4. In how many number of ways can a heap be formed with n distinct integers?
Q5. Show that the worst-case running time of heapsort is Ω(nlogn)?
Q6. Find the k maximum elements in an array, using min heap.
Q7. Given n queries, after every query you have to tell the median of the queries till now.
Q8. What is the running time of heapsort on an array A of length n that is already sorted in decreasing order?

Hashing

Q1. Given an array A containing n elements. The problem is to find maximum number of distinct elements after removing k elements from the array.
Q2. Find a way (and hash function), using which you can find hash of any substring in O(1) with pre-processing of O(n) and memory space O(n).
Q3. Suppose that a dynamic set S is represented by a direct-address table T of length m. Describe a procedure that finds the maximum element of S. What is the worst-case performance of your procedure?
Q4. We define a string to be k-palindrome, if it is a palindrome itself, and it's prefix and suffix of length floor(n/2) are k-1 palindromes. Any string which is not a palindrome is said to be 0-palindrome. For a given string s, find out the sum of k (maximum possible) for each prex of s. Expected solution's complexity: O(n).
Q5. Come up with an algorithm to find out number of distinct sub-trees of a tree. The tree is unlabelled, so you have to figure out a way to capture the structure of a tree.

2-3 Trees

Q1. Consider the following intermediate state of a 2-3 tree -



Perform the following operations on the tree -
1) Lookup for value 8
2) Lookup for value 11
3) Insert elements 16,17,18
4) Insert value 0
5) Delete Elements 11,12,16

Q2. Draw two different 2-3 trees, both containing the letters A through G as key values.

Link to Resource

Binary Search Trees

Q1. Given a Binary Search Tree and a SUM. Propose an algorithm to check if there exists any triplet (group of 3 elements) in the given BST with the given SUM.
Q2. Given an array A, propose an algorithm to remove minimum number of elements such that after their removal, max(A) <= 2 * min(A).
Q3. Given a Binary Search Tree, the task is to find the node with the maximum value in a BST.
Q4. Given a Binary Search Tree (BST) and a range [min, max], propose an algorithm to remove all the keys which are inside the given range. The modified tree should also be BST.
Q5. MCQs