APS Assignment 2

Deadline: 10:00 AM (11 september 2019)

PROBLEM 1

Implement a B-Tree for integers.

B-Trees are self balancing search trees like AVL, Red-Black trees. But unlike those, in B-Trees we can store more than 1 value in a node and each node can have more than 2 children. Since each node stores a relatively large number of keys, B-Trees becomes well suited for secondary storage where we read data in large chunks. Similarly this makes B-Trees more cache efficient than BSTs. Implementation :

Your task is to make an in memory B-Tree (We do not expect a disk based implementation).
Maximum number of keys per node should be kept configurable (at least something which can be changed before compilation). And you have to implement following operations for it -

Insert : worst case O(log n) **[40 Marks]**
Delete : worst case O(log n) **[40 Marks]**
Search : worst case O(log n) **[20 Marks]**

Input format : Q queries of following format -
1 x - insert x
2 x - search x
3 x - delete x

PROBLEM 2

Implement ordered set with suitable data structure.

An ordered set is a common data structure that supports O(log N) lookups, insertions and removals. Ordered set is also sometimes used as an alternative to a hash map, for example in STL's map.
Following operation should be implemented on ordered set.

- O(log N) insertion and removal. **[40 Marks]**
- O(log N) check if contains a value. **[10 Marks]**
- O(log N) to find the element in the set closest to some value. **[10 Marks]**
- O(log N) to find k-th largest element in the set. **[20 marks]**
- O(log N) to count the number of elements in the set whose values fall into a given range. **[20 Marks]**

AIM:To have end to end knowledge of ordered set and how it can help in variety of problems.
Parameter to Judge: Time and space complexity.

PROBLEM 3

In a sorted array of integers , median of the array is defined as follows

- If there are odd numbers of elements in an array , median element is the middle of that array E.x [1 , 2 , 3] median is 2 and for [1 , 3 , 3] median is 3
- If there are even numbers of elements in an array , median element is average of two middle elements of that array E.x [1 , 2 , 3 , 4] median is (2 + 3) / 2 and for [1 , 3 , 3 , 5] median is 3.

  Problem Description : Given a stream of integers , after occurrence of every number , output the median of array.

  Example: Given sequence is 5 , 7 , 1 , 6 , 2 , 3
  Explanation: [5] median is 5 [5 , 7] median is (5+7)/2 [5 7 1] sorted array is [1 5 7] median is 5 [5 7 1 6] sorted array is [1 5 6 7] median is (5 + 6)/2.

  Crux of Problem: It has to be solely implemented using AVL Tree otherwise 0 marks will be awarded.

IMPORTANT POINTS

Languages Allowed: C/C++
Submission Format: Roll No_Question No.cpp Ex: For question 1, 2019201001_Q1.cpp.Copy all the codes in a folder with name as your roll no. and submit the zip file in moodle. Ex: 2019201001.zip

Note1: All those submissions which are not in the specified format or submitted after the deadline will be awarded 0 in assignment.
Note2: Any case of **plagiarism** will lead to **0** in assignment or "**F"** in the course.
Note3: Accuracy will be tested on the basis of test cases passed which will be provided during evaluation.