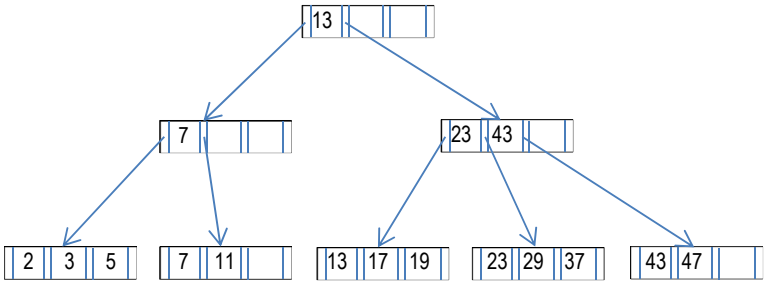
1.

a) Given the following B$^+$-tree, insert the search-key values 31, 41, 40 in order.



b) For the resultant B$^+$-tree in a), show the form of the tree after deleting 7, 11, 43, 37 and 41 in order.

c) Re-create the resultant B$^+$-tree in a), i.e., rebuild the tree from an empty tree, using ***bottom-up B$^+$-tree construction***.

2. Consider a hash function on integer search keys i defined by $h(i) = i^2 \bmod B$, where B is the number of buckets. What is wrong with this hash function if $B = 10$?

3. A PARTS file with Part# as hash key includes records with the following Part# values: 2369, 3760, 4692, 4871, 5659, 1821, 1074, 7115, 1620, 2428, 3943, 4750, 6975, 4981, 9208. The file uses 8 buckets, numbered 0 to 7. Each bucket is one disk block and holds two records. Load these records into the file in the given order using the hash function $h(K)=K \bmod 8$. Calculate the average number of block accesses for a random retrieval on Part#.