获得的答案

A red-black tree is a binary search tree that takes one extra bit of storage per node to specify the color of the node as either RED or BLACK.

Red-black tree properties:

1. Every node can be either red or black.

2. The root node must be black.

3. All leaves are black.

4. If a parent node is red, then both children must be black.

5. Every path from a node to a leaf must contain the same number of black nodes.

Consider a red-black tree with black height as *k*. If each and every node is black, the maximum number of internal nodes is $2^k - 1$. Considering the property 4, and if there are alternative nodes as black, the height will be 2*k* and the maximum number of internal nodes is $2^{2k} - 1$.

As proved in lemma 13.1, the minimum number of internal nodes of the sub tree of *x* is $2^{bh(x)} - 1$.If the height of any node *x* is k, then the sub tree of *x* will contain minimum of $2^k - 1$ internal nodes..

Hence the largest possible number of internal nodes is $2^{2k} - 1$ and the smallest possible number of internal nodes is $2^k - 1$