

Black node only Red-Black Trees

Insert 1

Insert 1, 2, 3, 4. Then delete 4

Insert 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Then delete 10, 9, 8.

Insert 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22. Then delete 22, 21, 20, 19, 18, 17, 16.

In other words, for $k > 0$,

Insert 1, 2, ..., $2^k + 2^{(k-1)} - 2$. Then start deleting $2^k + 2^{(k-1)} - 2$, ..., 2^k . Then you will have a complete binary tree with all black nodes numbered 1, 2, ..., $2^k - 1$.