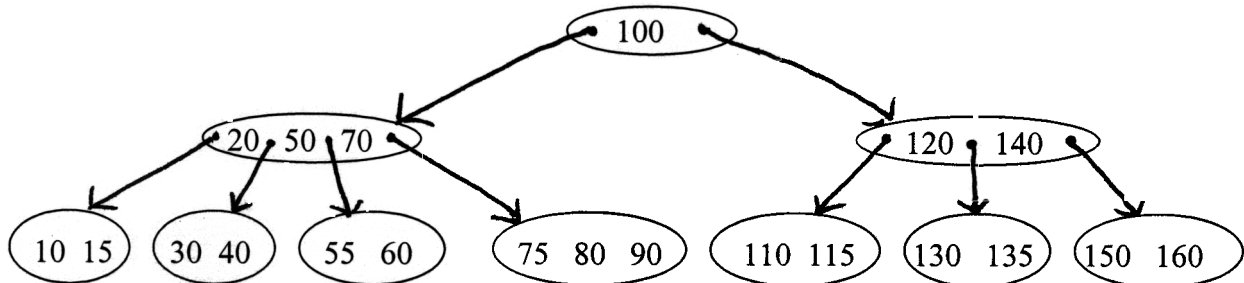


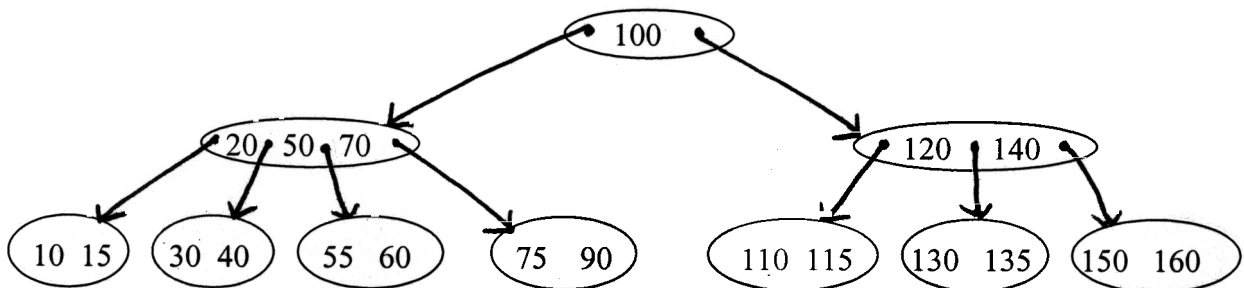
Deletion from a B-tree

Case 1: Deleting a key from a leaf node that has more than the required number of children. In all these examples, we deal with B-trees of order 5.

TREE #1



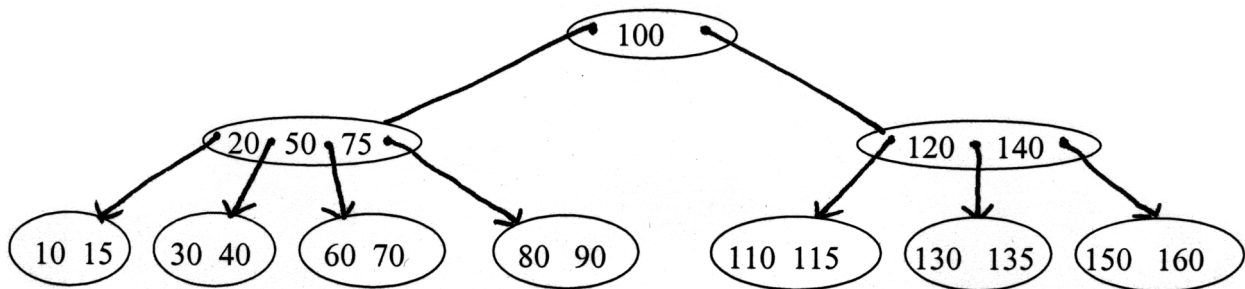
Remove key 80 from the above tree. The resulting tree would be



The number of disk accesses for the above deletion: 3R, 1W

Case 2: Removing a key from a leaf node that has exactly the required minimum number of children. In this case we try to borrow from an immediate sibling. We assume that we examine the immediate left sibling first and, if needed, we examine the immediate right sibling. (Note that if the current node is the leftmost child then left sibling for this node does not exist). Also note that we cannot borrow a key directly from a sibling and use it straightaway. We need to take a key from a sibling and give it to the parent and borrow from the parent.

Removing key 55 from Tree #1:

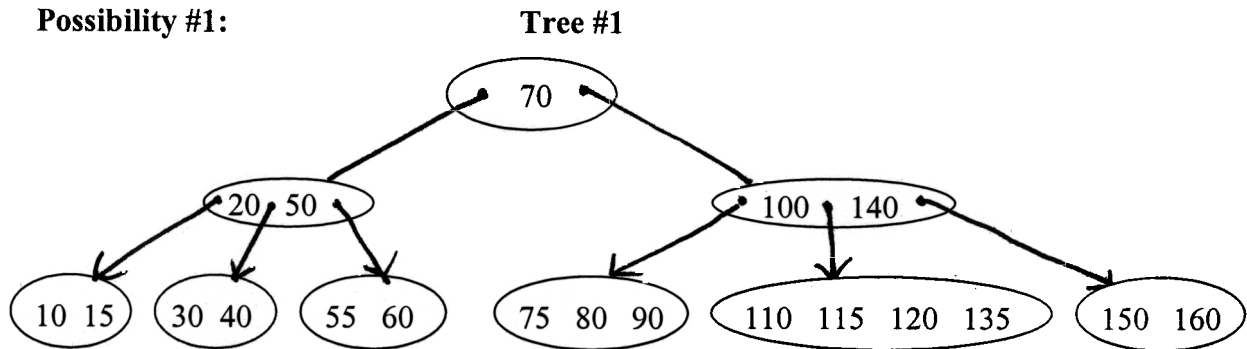


Number of disk accesses for this deletion: 5R and 3W

Case 3: If none of the siblings (immediate left or immediate right) can give you a key, then we combine the current node with a sibling and a key from the parent to form a full node. (Notice that this might leave the parent with less than the minimum required number of children, which we would consider next).

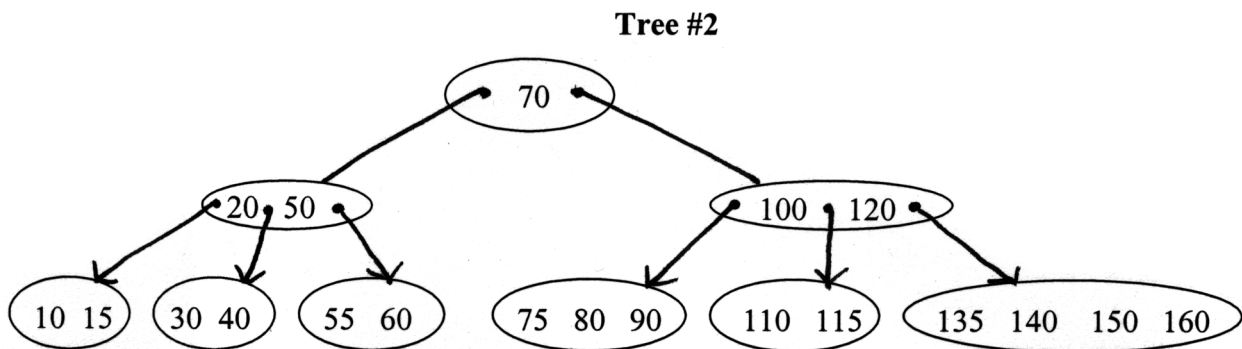
Removal of key 130 from Tree #1 on page #1: There are two possibilities.

Possibility #1:



The number of disk accesses: 6R and 4W

Possibility #2:

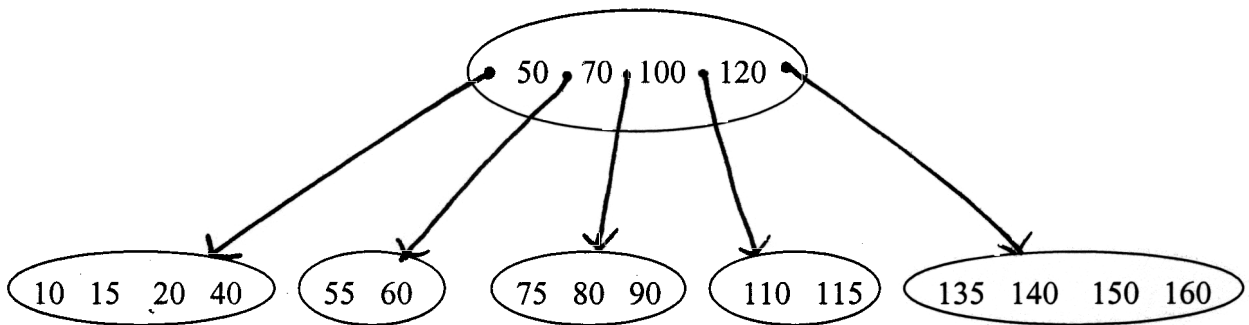


The number of disk accesses: 6R and 4W

Case 3 continued:

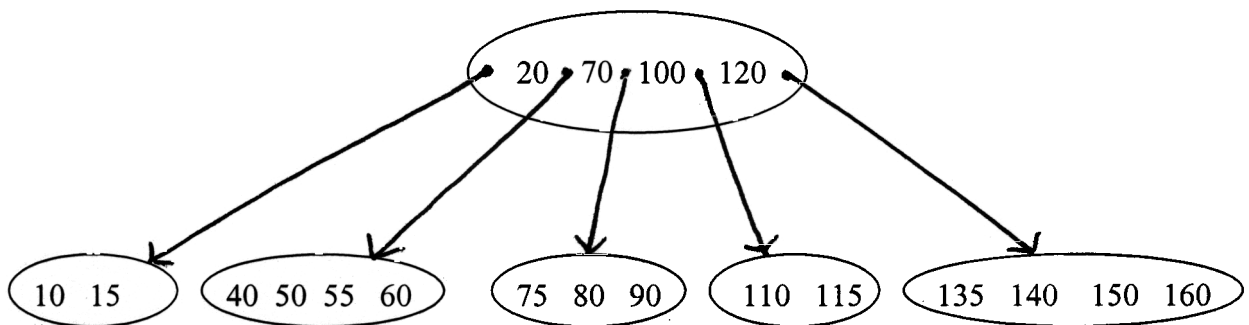
Deleting key 30 from Tree #2 on Page #3. There are two possibilities.

Possibility #1:



The number of disk accesses: 6R and 2W

Possibility #2:



The number of disk accesses: 6R and 2W

Note also that removing a key from an internal node is similar to removal of an internal node in a BST. Replace the key to be removed with the largest key from the immediate left sibling OR replace it with the smallest key from the immediate right sibling. Note that both of these keys would be found on leaf node. (After replacing, remove the key from the leaf node which we know how to do from the above examples)