Insertion in B Tree

B tree is a self-balancing search tree. It is a fat tree, in which a node holds many key values.
'M' is the order of the tree and most of the B tree properties are dependent on M.
It is usually implemented in secondary memory to reduce disk access time.

As, a single node stores M-1 key values and have maximum M children, height of B tree is low and time complexity for following operations are -

Search	O(log n)
Insert	O(log n)
Delete	O(log n)

Implementing using two classes - BtreeNode, Btree.

```
class BTreeNode
{
    int *keys; // Array for storing key values
    int t;     // Minimum degree
    BTreeNode **C; // Array of child pointers
    int n;     // current number of keys
    bool leaf; // is true when node is leaf node
    friend class BTree;
```

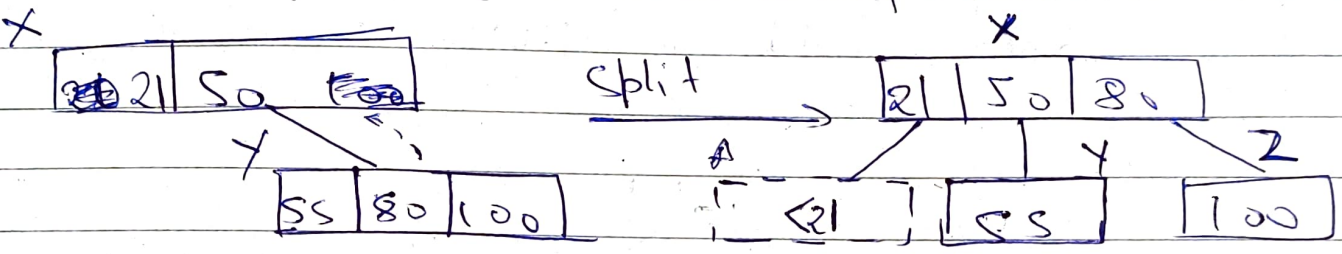
```
};
class BTree
{
    BTreeNode * root;
    int t;
    // Function to traverse
    // Function to search for key value
    // Function to insert
};

void BTree::insert(int data)
{
    if(root==NULL)
    {   // Inserting the value
        root= new BTreeNode(t, true);
        root->keys[0]=data;
        root-> n=1;
    }
    else // tree is not empty
    {
        if(root->n == 2*t-1)  // root is full
        {
            // Allocate memory for new root
            // Make old root as child of new root
            // Split old root and move
               middle key value to new root
            // insert the new key value to
               appropriate child of new root
    }
    else // If root is not full.
        root -> insertNonFull(data);
    }
}
```

Insertion is implemented using proactive insertion algorithm where before going down, we split the current node if it is full.

Advantage

1. Do not traverse a node twice
2. Always have a free space in the leaf node. (New key is always inserted at leaf node)



1. Initialize X as root
2. While X is not leaf, do following
   a) Find the child of x that is going to be traversed next. Let the child be y.
   b) If y is not full, change X to point to y
   c) If y is full, split it and change X to point to one of the two parts of y. If k is smaller than mid key in y, the set x as first part of y, else second part of y
3. The loop in step 2 stops when x is leaf. X must have space for extra key as we have been splitting all nodes in advance