109. Convert Sorted List to Binary Search Tree

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- **Depth-first Search** + Linked list

Description

Given a singly linked list where elements are sorted in ascending order, convert it to a height balanced BST.

For this problem, a height-balanced binary tree is defined as a binary tree in which the depth of the two subtrees of *every* node never differ by more than 1.

Example:

```
Given the sorted linked list: [-10,-3,0,5,9],

One possible answer is: [0,-3,9,-10,null,5], which represents the following height balanced BST:

      0
     / \
   -3   9
   /   /
 -10  5
```

1. Thought line

- Height-balanced BST
- Find the middle node in Linked List

```
//find the middle node of linked list
ListNode* dummyHeadLinkList = new ListNode(0);
dummyHeadLinkList->next = nodeList;
ListNode* ptr0 = dummyHeadLinkList;
ListNode* ptr1 = dummyHeadLinkList->next;  //mid spot
ListNode* ptr2 = dummyHeadLinkList->next->next;

while(ptr2 != nullptr && ptr2->next !=nullptr){
   ptr1 = ptr1->next;
   ptr2 = ptr2->next->next;
   ptr0 = ptr0->next;
}
```

- Get left half list and right half list.

```
// first half
ptr0->next = nullptr;
ListNode* firstHalf = dummyHeadLinkList->next;

// second half
ListNode* secondHalf = ptr1->next;
ptr1->next = nullptr;
```

2. Depth-first Search + Linked list

```
/**
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     ListNode *next;
 *     ListNode(int x) : val(x), next(NULL) {}
 * };
 */
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
void linkedListRoodFind(ListNode* nodeList, TreeNode* nodeTree, string str = "toRightChild"){
    if (nodeList == nullptr) return;

    //find the middle node of linked list
    ListNode* dummyHeadLinkList = new ListNode(0);
    dummyHeadLinkList->next = nodeList;
    ListNode* ptr0 = dummyHeadLinkList;
    ListNode* ptr1 = dummyHeadLinkList->next;  //mid spot
    ListNode* ptr2 = dummyHeadLinkList->next->next;

    while(ptr2 != nullptr && ptr2->next !=nullptr){
        ptr1 = ptr1->next;
        ptr2 = ptr2->next->next;
        ptr0 = ptr0->next;
    }

    // first half
    ptr0->next = nullptr;
    ListNode* firstHalf = dummyHeadLinkList->next;

    // second half
    ListNode* secondHalf = ptr1->next;
    ptr1->next = nullptr;

    if (str == "toRightChild"){
        nodeTree->right = new TreeNode(ptr1->val);
        linkedListRoodFind(firstHalf, nodeTree->right, "toLeftChild");
        linkedListRoodFind(secondHalf, nodeTree->right, "toRightChild");
    }
    else if (str == "toLeftChild"){
        nodeTree->left = new TreeNode(ptr1->val);
        linkedListRoodFind(firstHalf, nodeTree->left, "toLeftChild");
        linkedListRoodFind(secondHalf, nodeTree->left, "toRightChild");
    }

}

class Solution {
public:
    TreeNode* sortedListToBST(ListNode* head) {
        if (head==nullptr) return nullptr;
        TreeNode* dummyHead = new TreeNode(INT_MIN);
        linkedListRoodFind(head,dummyHead);
        return dummyHead->right;
    }
};
```