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// AVL tree implementation in C

#include <stdio.h>
#include <stdlib.h>

// Create Node
struct Node {
    int key;
    struct Node *left;
    struct Node *right;
    int height;
};

int max(int a, int b);

// Calculate height
int height(struct Node *N) {
    if (N == NULL)
        return 0;
    return N->height;
}

int max(int a, int b) {
    return (a > b) ? a : b;
}

// Create a node
struct Node *newNode(int key) {
    struct Node *node = (struct Node *)
        malloc(sizeof(struct Node));
    node->key = key;
    node->left = NULL;
    node->right = NULL;
    node->height = 1;
    return (node);
}

// Right rotate
struct Node *rightRotate(struct Node *y) {
    struct Node *x = y->left;
    struct Node *T2 = x->right;

    x->right = y;
    y->left = T2;

    y->height = max(height(y->left), height(y->right)) + 1;
    x->height = max(height(x->left), height(x->right)) + 1;

    return x;
}

// Left rotate
struct Node *leftRotate(struct Node *x) {
    struct Node *y = x->right;
    struct Node *T2 = y->left;

    y->left = x;
    x->right = T2;

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    x->height = max(height(x->left), height(x->right)) + 1;
    y->height = max(height(y->left), height(y->right)) + 1;

    return y;
}

// Get the balance factor
int getBalance(struct Node *N) {
    if (N == NULL)
        return 0;
    return height(N->left) - height(N->right);
}

// Insert node
struct Node *insertNode(struct Node *node, int key) {
    // Find the correct position to insertNode the node and insertNode it
    if (node == NULL)
        return (newNode(key));

    if (key < node->key)
        node->left = insertNode(node->left, key);
    else if (key > node->key)
        node->right = insertNode(node->right, key);
    else
        return node;

    // Update the balance factor of each node and
    // Balance the tree
    node->height = 1 + max(height(node->left),
                          height(node->right));

    int balance = getBalance(node);
    if (balance > 1 && key < node->left->key)
        return rightRotate(node);

    if (balance < -1 && key > node->right->key)
        return leftRotate(node);

    if (balance > 1 && key > node->left->key) {
        node->left = leftRotate(node->left);
        return rightRotate(node);
    }

    if (balance < -1 && key < node->right->key) {
        node->right = rightRotate(node->right);
        return leftRotate(node);
    }

    return node;
}

struct Node *minValueNode(struct Node *node) {
    struct Node *current = node;

    while (current->left != NULL)
        current = current->left;
}

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    return current;
}

// Delete a nodes
struct Node *deleteNode(struct Node *root, int key) {
    // Find the node and delete it
    if (root == NULL)
        return root;

    if (key < root->key)
        root->left = deleteNode(root->left, key);

    else if (key > root->key)
        root->right = deleteNode(root->right, key);

    else {
        if ((root->left == NULL) || (root->right == NULL)) {
            struct Node *temp = root->left ? root->left : root->right;

            if (temp == NULL) {
                temp = root;
                root = NULL;
            } else
                *root = *temp;
            free(temp);
        } else {
            struct Node *temp = minValueNode(root->right);

            root->key = temp->key;

            root->right = deleteNode(root->right, temp->key);
        }
    }

    if (root == NULL)
        return root;

    // Update the balance factor of each node and
    // balance the tree
    root->height = 1 + max(height(root->left),
                           height(root->right));

    int balance = getBalance(root);
    if (balance > 1 && getBalance(root->left) >= 0)
        return rightRotate(root);

    if (balance > 1 && getBalance(root->left) < 0) {
        root->left = leftRotate(root->left);
        return rightRotate(root);
    }

    if (balance < -1 && getBalance(root->right) <= 0)
        return leftRotate(root);

    if (balance < -1 && getBalance(root->right) > 0) {
        root->right = rightRotate(root->right);
        return leftRotate(root);
    }
}

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    return root;
}

// Print the tree
void printPreOrder(struct Node *root) {
    if (root != NULL) {
        printf("%d ", root->key);
        printPreOrder(root->left);
        printPreOrder(root->right);
    }
}

int main() {
    struct Node *root = NULL;

    root = insertNode(root, 2);
    root = insertNode(root, 1);
    root = insertNode(root, 7);
    root = insertNode(root, 4);
    root = insertNode(root, 5);
    root = insertNode(root, 3);
    root = insertNode(root, 8);

    printPreOrder(root);

    root = deleteNode(root, 3);

    printf("\nAfter deletion: ");
    printPreOrder(root);

    return 0;
}

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4 2 1 3 7 5 8
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After deletion: 4 2 1 7 5 8
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...Program finished with exit code 0
Press ENTER to exit console.
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