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#include <iostream>
#include <queue>
#include <stack>
using namespace std;

struct Node {
    int data;
    Node* left;
    Node* right;
    Node(int val) : data(val), left(nullptr), right(nullptr) {}
};

class BST {
private:
    Node* root;

    Node* insert(Node* node, int val) {
        if (!node) return new Node(val);
        if (val < node->data)
            node->left = insert(node->left, val);
        else
            node->right = insert(node->right, val);
        return node;
    }

    Node* deleteNode(Node* node, int val) {
        if (!node) return node;
        if (val < node->data)
            node->left = deleteNode(node->left, val);
        else if (val > node->data)
            node->right = deleteNode(node->right, val);
        else {
            if (!node->left) return node->right;
            if (!node->right) return node->left;
            Node* minNode = minValueNode(node->right);
            node->data = minNode->data;
            node->right = deleteNode(node->right, minNode->data);
        }
        return node;
    }

    Node* minValueNode(Node* node) {
        while (node && node->left)
            node = node->left;
        return node;
    }

    bool search(Node* node, int val) {

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        if (!node) return false;
        if (node->data == val) return true;
        return val < node->data ? search(node->left, val) : search(node-
>right, val);
    }

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void display(Node* node) {
    if (node) {
        display(node->left);
        cout << node->data << " ";
        display(node->right);
    }
}

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int depth(Node* node) {
    if (!node) return 0;
    int leftDepth = depth(node->left);
    int rightDepth = depth(node->right);
    return max(leftDepth, rightDepth) + 1;
}

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void mirror(Node* node) {
    if (node) {
        swap(node->left, node->right);
        mirror(node->left);
        mirror(node->right);
    }
}

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Node* copy(Node* node) {
    if (!node) return nullptr;
    Node* newNode = new Node(node->data);
    newNode->left = copy(node->left);
    newNode->right = copy(node->right);
    return newNode;
}

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void displayLeafNodes(Node* node) {
    if (node) {
        if (!node->left && !node->right) {
            cout << node->data << " ";
        }
        displayLeafNodes(node->left);
        displayLeafNodes(node->right);
    }
}

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void displayParentNodes(Node* node) {

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        if (node) {
            if (node->left || node->right) {
                cout << node->data << " ";
            }
            displayParentNodes(node->left);
            displayParentNodes(node->right);
        }
    }

void levelOrder(Node* node) {
    if (!node) return;
    queue<Node*> q;
    q.push(node);
    while (!q.empty()) {
        Node* curr = q.front();
        q.pop();
        cout << curr->data << " ";
        if (curr->left) q.push(curr->left);
        if (curr->right) q.push(curr->right);
    }
}

public:
    BST() : root(nullptr) {}

    void insert(int val) {
        root = insert(root, val);
    }

    void deleteNode(int val) {
        root = deleteNode(root, val);
    }

    bool search(int val) {
        return search(root, val);
    }

    void display() {
        display(root);
        cout << endl;
    }

    int depth() {
        return depth(root);
    }

    void mirror() {
        mirror(root);
        cout << "Tree mirrored." << endl;
    }

    BST copy() {
        BST newTree;

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        newTree.root = copy(root);
        return newTree;
    }

    void displayLeafNodes() {
        displayLeafNodes(root);
        cout << endl;
    }

    void displayParentNodes() {
        displayParentNodes(root);
        cout << endl;
    }

    void levelOrder() {
        levelOrder(root);
        cout << endl;
    }
};

int main() {
    BST tree;
    int baseElements[] = {5, 3, 7, 2, 4, 6, 8};

    for (int val : baseElements) {
        tree.insert(val);
    }

    int choice, value;
    do {
        cout << "\nBinary Search Tree Operations Menu (Given Elements =
5, 3, 7, 2, 4, 6, 8):\n";
        cout << "1. Insert\n";
        cout << "2. Delete\n";
        cout << "3. Search\n";
        cout << "4. Display (In-order)\n";
        cout << "5. Depth of Tree\n";
        cout << "6. Mirror the Tree\n";
        cout << "7. Create a Copy of the Tree\n";
        cout << "8. Display Leaf Nodes\n";
        cout << "9. Display Parent Nodes\n";
        cout << "10. Level Order Display\n";
        cout << "11. Exit\n";
        cout << "Enter your choice: ";
        cin >> choice;

        switch (choice) {
            case 1:
                cout << "Enter value to insert: ";
                cin >> value;
                tree.insert(value);
                break;
            case 2:
                cout << "Enter value to delete: ";

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        cin >> value;
        tree.deleteNode(value);
        break;
    case 3:
        cout << "Enter value to search: ";
        cin >> value;
        cout << (tree.search(value) ? "Found" : "Not Found") <<
endl;
        break;
    case 4:
        cout << "In-order display: ";
        tree.display();
        break;
    case 5:
        cout << "Depth of the tree: " << tree.depth() << endl;
        break;
    case 6:
        tree.mirror();
        break;
    case 7: {
        BST copiedTree = tree.copy();
        cout << "Copied tree (In-order): ";
        copiedTree.display();
        break;
    }
    case 8:
        cout << "Leaf nodes: ";
        tree.displayLeafNodes();
        break;
    case 9:
        cout << "Parent nodes: ";
        tree.displayParentNodes();
        break;
    case 10:
        cout << "Level order display: ";
        tree.levelOrder();
        break;
    case 11:
        cout << "Exiting." << endl;
        break;
    default:
        cout << "Invalid choice! Please try again." << endl;
    }
} while (choice != 11);

return 0;
}

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