Lab Manual 04

DATA STRUCTURE

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Contents

Objectives

a) Understanding the concepts of Binary Tree and its operations.
b) Implement CRUD operations.

Exercise 3.1: Family Tree Structure.

Implement a family tree in c++ using a tree structure, where each node represents a family member, and the relations are determined by yes/no questions about family side (e.g mother's side vs. father's side). You need to implement the following CRUD operations and the search operation for the binary tree:

1. **Create:** add a new family member to the tree (either as a left or right child, representing either the mother's or father's side).

2. **Read:** display the entire family tree starting from the root, showing the family relations in a yes/no format (e.g is this person from your mother's side?).

3. **Update:** modify the details of an existing family member (e.g changing thier name or relation).

4. **Delete:** remove a family member from the tree(i.e delete a node from the tree).

5. **search:** search for a family member by name. if found, display their relation and position in the family tree.

6. **Additional requirement:** after implementing the CRUD operations and seach , allow the user to interact with the tree by answering yes/no questions to trace thier family tree, ending at a leaf node where the final family member is displayed.

Source Code and Outputs

Exercise 4 .1 Code

```
#include <iostream>

#include <string>

using namespace std;


struct FamilyMember {

   string name;

   string relation;

   FamilyMember *left;
```

```
  FamilyMember *right;
};

class FamilyTree {

        private:
    FamilyMember *root;
public:
  FamilyTree() {
    root = nullptr;
  }

  void display(FamilyMember *node) {
    if (node) {
      cout << node->name << " (" << node->relation << ")\n";
      display(node->left);
      display(node->right);
    }
  }

  FamilyMember *find(FamilyMember *node, string name) {
    if (!node || node->name == name)
      return node;
    FamilyMember *found = find(node->left, name);
    return found ? found : find(node->right, name);
  }
```

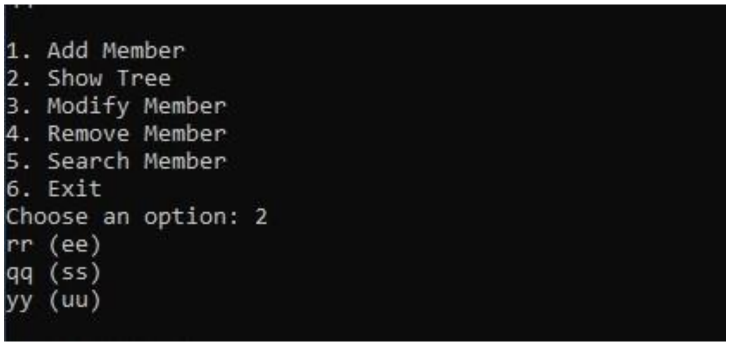
```
FamilyMember *remove(FamilyMember *node, string name) {
    if (!node)
        return nullptr;
    if (node->name == name) {
        if (!node->left && !node->right) {
            delete node;
            return nullptr;
        }
        if (node->left && !node->right) {
            FamilyMember *temp = node->left;
            delete node;
            return temp;
        }
        if (!node->left && node->right) {
            FamilyMember *temp = node->right;
            delete node;
            return temp;
        }
    }
    node->left = remove(node->left, name);
    node->right = remove(node->right, name);
    return node;
}

void add(string name, string relation, bool isMotherSide = true) {
    FamilyMember *newMember = new FamilyMember{name, relation, nullptr, nullptr};

    if (!root) {

        root = newMember;

        cout << "Root member added: " << name << endl;

        return;

    }


    FamilyMember *current = root;

    while (true) {

        if (isMotherSide) {

            if (!current->left) {

                current->left = newMember;

                cout << name << " added on mother's side." << endl;

                break;

            }

            current = current->left;

        } else {

            if (!current->right) {

                current->right = newMember;

                cout << name << " added on father's side." << endl;

                break;

            }

            current = current->right;

        }

    }

}
```

```
void showTree() {
    if (!root) {
        cout << "Family tree is empty." << endl;
        return;
    }
    display(root);
}

void modify(string name, string newName, string newRelation) {
    FamilyMember *member = find(root, name);
    if (member) {
        member->name = newName;
        member->relation = newRelation;
        cout << "Member updated: " << newName << " (" << newRelation << ")" << endl;
    } else {
        cout << "Member not found!" << endl;
    }
}

void removeMember(string name) {
    root = remove(root, name);
}

void search(string name) {
    FamilyMember *member = find(root, name);
```

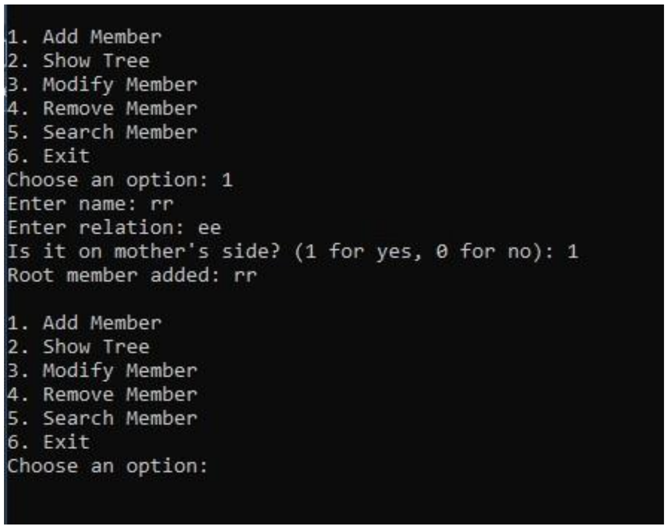
```
        if (member) {
            cout << "Found: " << member->name << " (" << member->relation << ")" << endl;
        } else {
            cout << "Member not found!" << endl;
        }
    }
};


int main() {
    FamilyTree family;
    int choice;
    while (true) {
        cout << "\n1. Add Member\n2. Show Tree\n3. Modify Member\n4. Remove
Member\n5. Search Member\n6. Exit\nChoose an option: ";
        cin >> choice;
        cin.ignore();


        switch (choice) {
            case 1: {
                string name, relation;
                int isMotherSide;
                cout << "Enter name: ";
                getline(cin, name);
                cout << "Enter relation: ";
                getline(cin, relation);
                cout << "Is it on mother's side? (1 for yes, 0 for no): ";
    cin >> isMotherSide;

    family.add(name, relation, isMotherSide);

    break;

}

case 2:

    family.showTree();

    break;

case 3: {

    string name, newName, newRelation;

    cout << "Enter name to modify: ";

    getline(cin, name);

    cout << "Enter new name: ";

    getline(cin, newName);

    cout << "Enter new relation: ";

    getline(cin, newRelation);

    family.modify(name, newName, newRelation);

    break;

}

case 4: {

    string name;

    cout << "Enter name to remove: ";

    getline(cin, name);

    family.removeMember(name);

    break;

}

case 5: {
```

```
                string name;
                cout << "Enter name to search: ";
                getline(cin, name);
                family.search(name);
                break;
            }
            case 6:
                cout << "Exiting..." << endl;
                return 0;
            default:
                cout << "Invalid choice! Try again." << endl;
        }
    }

    return 0;
}
```

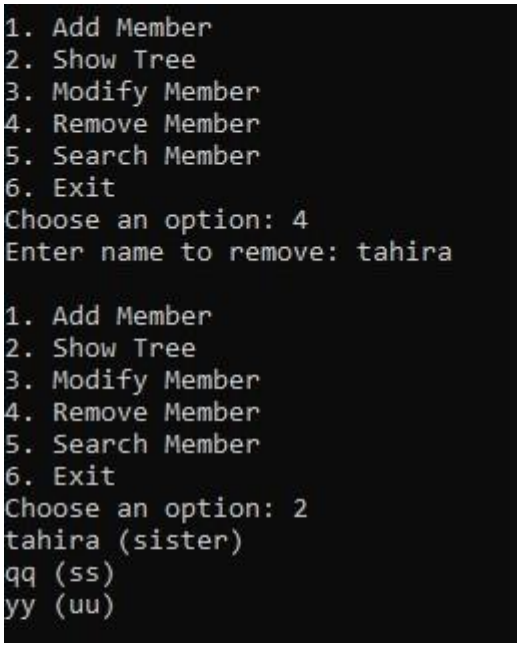
Output:



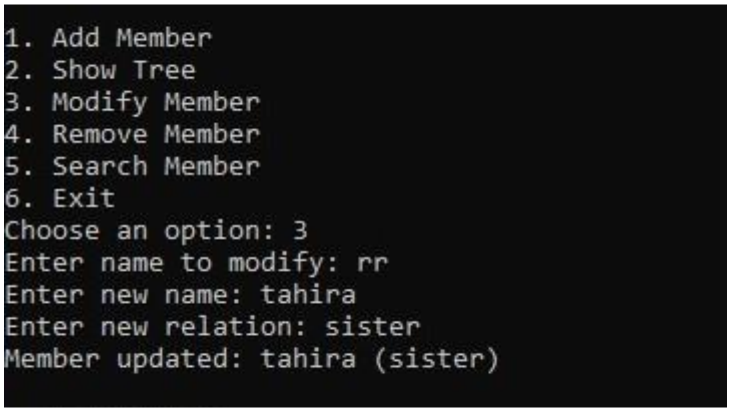
```
1. Add Member
2. Show Tree
3. Modify Member
4. Remove Member
5. Search Member
6. Exit
Choose an option: 2
rr (ee)
qq (ss)
yy (uu)
```



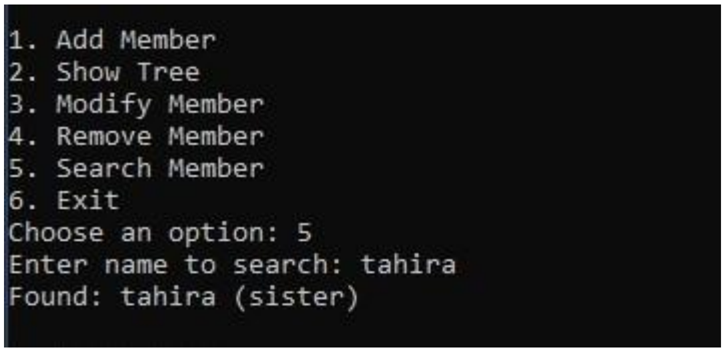
```
1. Add Member
2. Show Tree
3. Modify Member
4. Remove Member
5. Search Member
6. Exit
Choose an option: 1
Enter name: rr
Enter relation: ee
Is it on mother's side? (1 for yes, 0 for no): 1
Root member added: rr

1. Add Member
2. Show Tree
3. Modify Member
4. Remove Member
5. Search Member
6. Exit
Choose an option:
```



```
1. Add Member
2. Show Tree
3. Modify Member
4. Remove Member
5. Search Member
6. Exit
Choose an option: 4
Enter name to remove: tahira

1. Add Member
2. Show Tree
3. Modify Member
4. Remove Member
5. Search Member
6. Exit
Choose an option: 2
tahira (sister)
qq (ss)
yy (uu)
```



```
1. Add Member
2. Show Tree
3. Modify Member
4. Remove Member
5. Search Member
6. Exit
Choose an option: 3
Enter name to modify: rr
Enter new name: tahira
Enter new relation: sister
Member updated: tahira (sister)
```



```
1. Add Member
2. Show Tree
3. Modify Member
4. Remove Member
5. Search Member
6. Exit
Choose an option: 5
Enter name to search: tahira
Found: tahira (sister)
```