

Data Structures- Assignment 4

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Section I.1. System Overview

This program handles the reading, organization and output of users in some database using a binary tree and a directed graph

Section I.1.1. Referenced Documents

No references were made.

Section I.1.2. Concept of Execution

A database of users will be read in from a text file and be outputted to the console and another text file.

Section I.1.3. Abstract Data Type

The binary tree and graph abstract data types were used.

Section I.2. Code Outline

Class: User

```
void Initialize(const char* afName, const char* alName, char aGender, const char* aMajor,
const char* aEmail, AddressType aAddress, float aGPA, DateType aDateOfBirth);
void GetFirstName(char afname[]) const;
void GetLastName(char alname[]) const;
void GetMajor(char amajor[]) const;
void GetEmail(char aemail[]) const;
void GetGender(char& agender) const;
DateType GetDateOfBirth() const;
void GetDateOfBirth(DateType& aDateOfBirth) const;
float GetGPA() const;
void GetGPA(float& aGPA) const;
AddressType GetAddress() const;
void GetAddress(AddressType& aAddress) const;
void GetAddress(char aStreetName[], int& aStreetNo, char aCity[], int& aZip, char aState[])
const;
void SetFirstName(const char* afName);
void SetLastName(const char* alName);
void SetMajor(const char* amajor);
void SetEmail(const char* anemail);
void SetGender(char aGender);
void SetDateOfBirth(DateType aDateOfBirth);
void SetGPA(float aGPA);
void SetAddress(AddressType aAddress);
void SetAddress(char aStreetName[], int aStreetNo, char aCity[], int aZip, char aState[]);
void Display() const;
void Display(std::ofstream& outFile) const;
RelationType comparedTo(User* aUser) const;
```

Class: Test Driver

```
int Populate(const char* input, User users[]);
int Populate(const char* input, UnsortedType& allUnsortedUsers) const;
int Populate(const char* input, SortedType& allSortedUsers) const;
void Test(User users[], int count) const;
void Test(std::ofstream& outFile, User users[], int count) const;
void TestList(UnsortedType& allUnsortedUsers) const;
void TestList(std::ofstream& outFile, UnsortedType& allUnsortedUsers) const;
void TestList(SortedType& allSortedUsers) const;
void TestList(std::ofstream& outFile, SortedType& allSortedUsers) const;
```

Class: UnsortedType

```
void MakeEmpty();
bool IsFull() const;
int GetLength() const;
void ResetList();
User* GetUser(char fname[], char lname[], bool& found) const;
virtual void PutUser(User* user);
void DeleteUser(User* user);
User* GetNextUser();
void Print() const;
void Print(std::ofstream& out) const;
void PrintPartial() const;
void PrintPartial(std::ofstream& out) const;
```

Class: SortedType (inherits from UnsortedType)

```
void PutUser(User* user);
```

Class: DateType

```
void Initialize(int newMonth, int newDay, int newYear);
RelationType comparedTo(DateType aDate) const;
```

Class: GraphType

```
void AddVertex(User* user);
void AddEdge(User* fromVertex, User* toVertex);
User* findSibling(User* user1);
void DisplayAncestors(User* user1);
void DisplayAncestors(std::ofstream& outFile, User* user1);
User* FindEarliestCommonAncestor(User* user1, User* user2);
void PrintAdjacencyMatrix();
void PrintAdjacencyMatrix(std::ofstream& outFile);
User* GetVertex(int vertex);
```

Section I.2.1. Detailed Design

Class: User

void Initialize(const char* afName, const char* alName, char aGender, const char* aMajor, const char* aEmail, AddressType aAddress, float aGPA, DateType aDateOfBirth);

Purpose: Creates a new user

Arguments: Char arrays for the user's first name, last name, major and email. A float for GPA. An AddressType for the user's address and DateType for the user's date of birth.

Return Value: Void

void GetFirstName(char afname[]) const;

Purpose: Gets the user's first name

Arguments: A character array that is the user's first name

Return Value: Void

void GetLastName(char alname[]) const;

Purpose: Gets the user's last name.

Arguments: A character array that is the user's last name

Return Value: Void

void GetMajor(char amajor[]) const;

Purpose: Gets the user's major

Arguments: A char array that is the user's major

Return Value: Void

void GetEmail(char aemail[]) const;

Purpose: Gets the user's email

Arguments: A char array that is the user's email

Return Value:

void GetGender(char& agender) const;

Purpose: Gets the user's gender

Arguments: A char that is the user's gender

Return Value: Void

DateType GetDateOfBirth() const;

Purpose: Gets the user's date of birth

Arguments: None

Return Value: Returns a DateType which is three integers representing the user's date of birth

void GetDateOfBirth(DateType& aDateOfBirth) const;

Purpose: Gets the user's date of birth

Arguments: DateType which is three integers representing the user's date of birth

Return Value: Void

float GetGPA() const;

Purpose: Gets the user's GPA

Arguments: None

Return Value: Returns a float which is the user's GPA

void GetGPA(float& aGPA) const;

Purpose: Gets the user's GPA

Arguments: A float which is the user's GPA

Return Value: Void

AddressType GetAddress() const;

Purpose: Gets the user's address

Arguments: None

Return Value: Returns an AddressType which is three char arrays and two integers making up the user's address

void GetAddress(AddressType& aAddress) const;

Purpose: Gets the user's address

Arguments: An AddressType which is three char arrays and two integers making up the user's address

Return Value: Void

void GetAddress(char aStreetName[], int& aStreetNo, char aCity[], int& aZip, char aState[]) const;

Purpose: Gets the user's address

Arguments: Three char arrays and two integers making up the user's address

Return Value: Void

void SetFirstName(const char* afName);

Purpose: Sets the user's first name

Arguments: A char array of the user's new first name

Return Value: Void

void SetLastName(const char* alName);

Purpose: Sets the user's last name

Arguments: A char array of the user's new last name

Return Value: Void

void SetMajor(const char* amajor);

Purpose: Sets the user's major

Arguments: A char array of the user's new major

Return Value: Void

void SetEmail(const char* anemail);

Purpose: Sets the user's email

Arguments: A char array of the user's new email

Return Value: Void

void SetGender(char aGender);

Purpose: Sets the user's gender

Arguments: A char representing the user's gender

Return Value: Void

void SetDateOfBirth(DateType aDateOfBirth);

Purpose: Sets the user's date of birth

Arguments: A DateType of three integers representing the user's new birthday

Return Value: Void

void SetGPA(float aGPA);

Purpose: Sets the user's GPA

Arguments: A float representing the user's new GPA

Return Value: Void

void SetAddress(AddressType aAddress);

Purpose: Sets the user's address

Arguments: An AddressType of three char arrays and two integers representing the user's new address

Return Value: Void

void SetAddress(char aStreetName[], int aStreetNo, char aCity[], int aZip, char aState[]);

Purpose: Sets the user's new address

Arguments: Three char arrays and two integers representing the user's new address

Return Value: Void

void Display() const;

Purpose: Displays all the data from the user to the console

Arguments: None

Return Value: Void

void Display(std::ofstream& outFile) const;

Purpose: Prints all the data of the user into a file

Arguments: An ofstream representing the file being printed to

Return Value: Void

RelationType comparedTo(User* aUser) const;

Purpose: Compares one user to another based on date type

Arguments: A user pointer to the user being compared

Return Value: Returns A RelationType which can either be LESS, GREATER or EQUAL

Class: Test Driver

int Populate(const char* input, User users[]);

Purpose: Reads in all users from a file into an users array

Arguments: A char array representing the file to read from and a users array to store the data into

Return Value: An integer representing the number of users that were read in

int Populate(const char* input, UnsortedType& allUnsortedUsers) const;

Purpose: Reads in all users from a file into an users linked list

Arguments: A char array representing the file to read from and an unsorted linked list to store the data into

Return Value: An integer representing the number of users that were read in

int Populate(const char* input, SortedType& allSortedUsers) const;

Purpose: Reads in all users from a file into an users linked list

Arguments: A char array representing the file to read from and a sorted linked list to store the data into

Return Value: An integer representing the number of users that were read in

void Test(User users[], int count) const;

Purpose: Tests the user class and its helpers class, printing results to the console

Arguments: An users array to test on and an integer representing the number of users in the user array.

Return Value: Void

void Test(std::ofstream& outFile, User users[], int count) const;

Purpose: Tests the user class and its helpers class, printing results to a file

Arguments: An ofstream representing the file being printed to, an users array to test on and an integer representing the number of users in the user array.

Return Value: Void

void TestList(UnsortedType& allUnsortedUsers) const;

Purpose: Tests the unsorted linked list and its helpers classes, printing results to the console

Arguments: An unsorted linked list full of users to run tests on

Return Value: Void

void TestList(std::ofstream& outFile, UnsortedType& allUnsortedUsers) const;

Purpose: Tests the unsorted linked list and its helpers classes, printing results to a file

Arguments: An ofstream representing the file being printed to and an unsorted linked list of users to test on.

Return Value: Void

void TestList(SortedType& allSortedUsers) const;

Purpose: Tests the sorted linked list and its helpers classes, printing results to the console

Arguments: A sorted linked list full of users to run tests on

Return Value: Void

void TestList(std::ofstream& outFile, SortedType& allSortedUsers) const;

Purpose: Tests the sorted linked list and its helpers classes, printing results to a file

Arguments: An ofstream representing the file being printed to and an unsorted linked list of users to test on.

Return Value: Void

Class: UnsortedType

void MakeEmpty();

Purpose: Deallocates the linked list of all its elements

Arguments: None

Return Value: Void

bool IsFull() const;

Purpose: Checks to see if there is free storage for another node on a linked list

Arguments: None

Return Value: A bool that is true if there is no more space to add onto the linked list

int GetLength() const;

Purpose: Gets the length of the linked list

Arguments: None

Return Value: returns an integer representing the length of the linked list

void ResetList();

Purpose: Resets the currentPos pointer to null so iteration can begin again

Arguments: None

Return Value: Void

User* GetUser(char fname[], char lname[], bool& found) const;

Purpose: Gets a user based on their first and last name from a linked list

Arguments: Two char arrays for the user's name and a bool for if the user was found or not.

Return Value: A pointer to the user that was found

virtual void PutUser(User* user);

Purpose: Adds a user to the unsorted linked list

Arguments: A pointer to a user that is added to the unsorted linked list

Return Value: Void

void DeleteUser(User* user);

Purpose: Deletes a user from the linked list

Arguments: A pointer to the user that is going to be deleted from the linked list

Return Value: Void

User* GetNextUser();

Purpose: Gets the next user in the linked list, iterating by one

Arguments: None

Return Value: A pointer to the user that was just iterated to

void Print() const;

Purpose: Prints the current nodes user to the console in the linked list

Arguments: None

Return Value: Void

void Print(std::ofstream& out) const;

Purpose: Prints the current nodes user to the output file in the linked list

Arguments: An ofstream for the user to be printed to

Return Value: Void

void PrintPartial() const;

Purpose: Prints the current node's user's name to the output file in the linked list

Arguments: None

Return Value: Void

void PrintPartial(std::ofstream& out) const;

Purpose: Prints the current node's user's name to the output file in the linked list

Arguments: An ofstream for the user to be printed to

Return Value: Void

Class: SortedType (inherits from UnsortedType)

void PutUser(User* user);

Purpose: Puts the user into the appropriate spot in the sorted linked list of users

Arguments: A pointer to a user that is being inserted into the sorted linked list

Return Value: Void

Class: DateType

void Initialize(int newMonth, int newDay, int newYear);

Purpose: Creates a new datatype object with filled out integer variables

Arguments: Three integers representing the new date's month, day and year.

Return Value: Void

RelationType comparedTo(DateType aDate) const;

Purpose: Compares dates to see if one is greater than the other or if they are equal

Arguments: a DateType to compare the current DateType to

Return Value: A relationtype that is either GREATER, LESS or EQUAL depending on the compared dates

Class: GraphType

void AddVertex(User* user);

Purpose: Adds a user to the graph

Arguments: A pointer to the user being added to the graph

Return Value: Void

void AddEdge(User* fromVertex, User* toVertex);

Purpose: Adds a parent-child relation to the graph from one user to another

Arguments: Two pointers to users that are the from and to users in the parent-child edge relationship

Return Value: Void

User* findSibling(User* user1);

Purpose: Finds the sibling of the inputted user

Arguments: A pointer to the user whose sibling is to be found

Return Value: A point to the user's sibling

void DisplayAncestors(User* user1);

Purpose: Prints out the ancestors of the user to the console

Arguments: A pointer to the user whose ancestors are to be found

Return Value: void

void DisplayAncestors(std::ofstream& outFile, User* user1);

Purpose: Prints out the ancestors of the user to a file

Arguments: An ofstream to print to a file and a pointer to the user whose ancestors are to be found

Return Value: void

User* FindEarliestCommonAncestor(User* user1, User* user2);

Purpose: Finds the earliest common ancestor between two users

Arguments: Pointers to the two users whose earliest common ancestor is to be found

Return Value: A pointer to the earliest common ancestor of the two users

void PrintAdjacencyMatrix();

Purpose: Prints the adjacency matrix to the console

Arguments: None

Return Value: Void

void PrintAdjacencyMatrix(std::ofstream& outFile);

Purpose: Prints the adjacency matrix to a file

Arguments: An ofstream to print to a file

Return Value: Void

User* GetVertex(int vertex);

Purpose: Gets a user from the graph based on their vertex index

Arguments: An int representing the vertex index

Return Value: A pointer to the user the vertex represents

Test Plan

This software is tested by the exhaustive method. Every method is called and every variable is used to confirm functionality.

Section II.1. Test Procedures

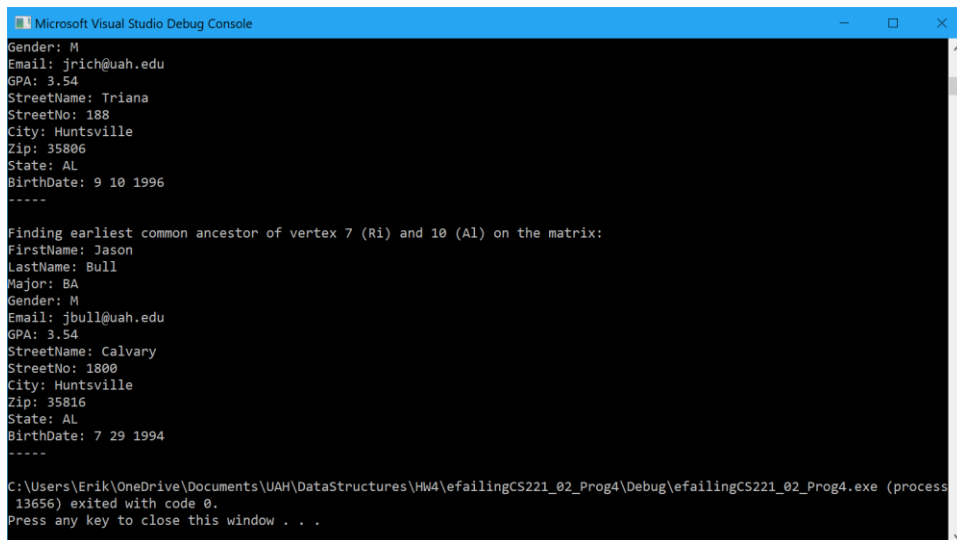
Main Testing

- Purpose - To test most of the methods
- Procedure - Reads in users to the binary tree and displays them. Then creates a graph from the binary tree and displays that. Finally, the singular graph methods are tested on different vertices.
- Inputs - Users
- Expected Outputs – A graph and binary tree of the users
- Success Criteria – The binary tree and graph build correctly.

Section II.2. Sample Runs

Sample Run 1:

- Inputs - Sample user text file hw1samplefile.txt
- Outputs - efailingHw4Outfile.txt
- Snapshots:

A screenshot of the Microsoft Visual Studio Debug Console window. The window has a blue title bar and a black background with white text. The text shows the program's output, including user data for two individuals and a message about finding a common ancestor. The first user's data includes Gender: M, Email: jrich@uah.edu, GPA: 3.54, StreetName: Triana, StreetNo: 188, City: Huntsville, Zip: 35806, State: AL, and BirthDate: 9 10 1996. The second user's data includes Gender: M, Email: jbull@uah.edu, GPA: 3.54, StreetName: Calvary, StreetNo: 1800, City: Huntsville, Zip: 35816, State: AL, and BirthDate: 7 29 1994. The program ends with a message indicating it exited with code 0.

```
Microsoft Visual Studio Debug Console
Gender: M
Email: jrich@uah.edu
GPA: 3.54
StreetName: Triana
StreetNo: 188
City: Huntsville
Zip: 35806
State: AL
BirthDate: 9 10 1996
-----
Finding earliest common ancestor of vertex 7 (Ri) and 10 (Al) on the matrix:
FirstName: Jason
LastName: Bull
Major: BA
Gender: M
Email: jbull@uah.edu
GPA: 3.54
StreetName: Calvary
StreetNo: 1800
City: Huntsville
Zip: 35816
State: AL
BirthDate: 7 29 1994
-----
C:\Users\Erik\OneDrive\Documents\UAH\DataStructures\HW4\efailingCS221_02_Prog4\Debug\efailingCS221_02_Prog4.exe (process
13656) exited with code 0.
Press any key to close this window . . .
```

```
Microsoft Visual Studio Debug Console
```

```
PRINTING DIRECTED ADJACENCY MATRIX FOR THE BINARY TREE:  
  
Jo 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0  
Jo 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0  
Ti 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Ad 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Ja 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Ma 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Ca 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Ri 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Mi 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Je 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Al 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0  
Ro 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Jo 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0  
Jo 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0  
Fr 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Al 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0  
Ke 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0  
Je 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0  
Sa 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
Co 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
  
Finding sibling of vertex 1 on the matrix:  
FirstName: Alice  
LastName: Rice  
Major: MATH  
Gender: F  
Email: alicerice@hotmail.com  
GPA: 3.65
```

