Project

<Time-Tracker>

CIS-17B

Name: Aleksandar Videv

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1.Introduction

The Time Manager is a sophisticated application designed to aid users in tracking their time effectively within educational or professional settings. The application leverages user authentication, detailed time tracking, and interactive menus to facilitate productivity and accountability. By offering precise tracking functionalities and user management capabilities, Time Manager ensures that users can focus on their tasks with enhanced efficiency.

2. Overview

2.1 Project Summary

The Time Manager application is detailed with its coding metrics as follows:

- **GitHub Repository**: Link
- **Total Lines of Code**: 1207
    - **Executable Lines**: 844
    - **Comment Lines**: 363
- **Variables**: 35+ (15 unique member variables, 20+ local variables)
- **Methods**: 35

Project Insights: Developed in C++, the Time Manager leverages various standard libraries to provide robust functionalities such as user data management and timer operations. Approximately 50 hours have been invested in the design and coding phases, excluding additional hours for documentation and debugging. The project is characterized by continuous incremental updates to improve its usability and adapt to the evolving needs of its users.

2.2 Versioning Scheme

Version 1: Initial version in a single C++ file, includes basic time tracking and user interface functionalities.

Version 2: Separates the TimeTracker class into its own header and source files, enhancing code maintainability and scalability.

Version 3: Introduces user management functionalities, adding classes for user properties and operations.

Version 4: Extends the User class to track detailed time (hours, minutes, seconds) and enhances user management capabilities.

Version 5: Incorporates a Menu class to centralize user interaction methods, linking time tracking directly to user accounts.

Version 6: Optimizes data handling by implementing fixed-size character arrays for user data, improving binary file I/O operations.

Version 7: Adds validated time input and robust error handling for file operations to enhance data integrity and application stability.

Version 8: Enhances user data security by introducing encryption and decryption functionalities in the UserManager class, ensuring secure data handling.

Version 9: Continues to focus on security with refined encryption processes and improved error handling, maintaining robust user data management.

Version 9_1: Implements comprehensive **Doxygen** documentation for all classes and methods, making the application more accessible for developers and maintainers.

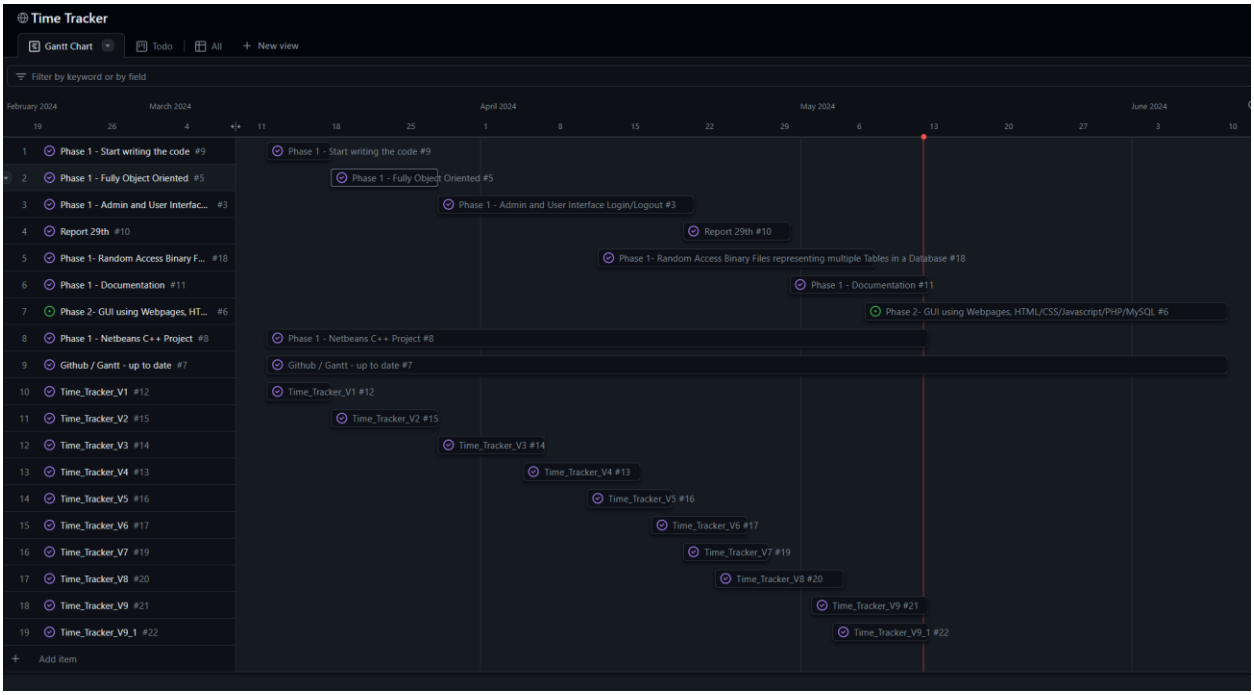
3. Project Description

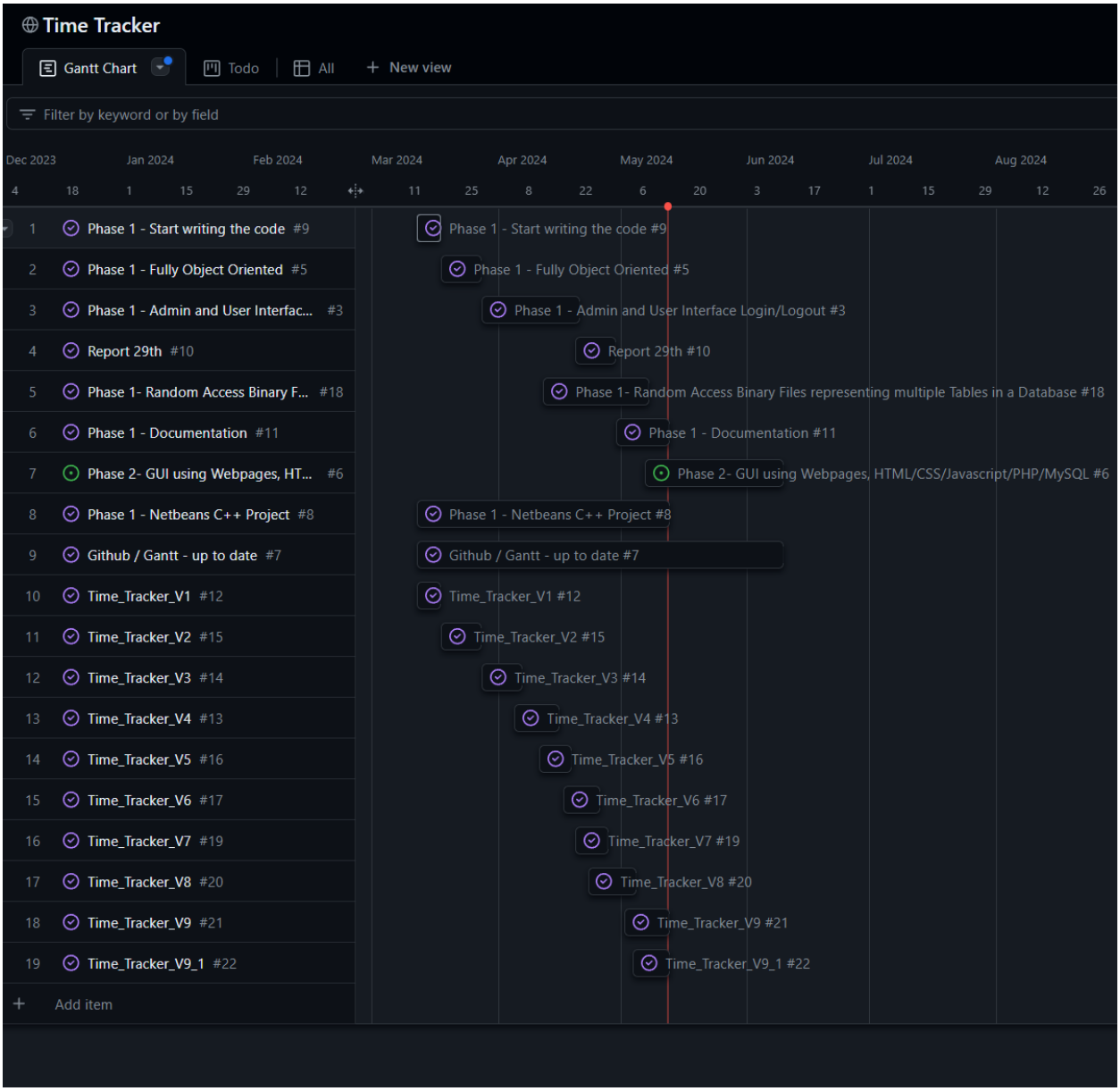
The Time Manager application has been refined with several key features to ensure robust functionality and an improved user experience:

- **Robust Time Tracking**: Enhancements to the Time Tracker module include mechanisms to prevent a timer from being started multiple times, ensuring the accuracy of recorded time and preventing data corruption.
- **Enhanced User Management**: The UserManager module now includes more sophisticated methods for user creation, editing, and deletion. These improvements cater to complex scenarios such as changing user roles or managing class information, making the system highly adaptable to diverse user needs.
- **Normalized Time Input and Display**: Time normalization across the system ensures that time data is consistently accurate and displayed correctly, which is crucial when editing user times or logging session durations.
- **Interactive and Responsive Menus**: The menu system has been structured to provide clear and intuitive pathways for user interaction, whether for system administration or time tracking. New checks and balances have been introduced to guide users effectively through their options, minimizing the likelihood of errors and enhancing the overall user experience.

4. Gantt Chart

The Gantt Chart can also be found here.




Time Tracker
Gantt Chart
Todo
All
New view
Filter by keyword or by field
Dec 2023
Jan 2024
Feb 2024
Mar 2024
Apr 2024
May 2024
Jun 2024
Jul 2024
Aug 2024
1 Phase 1 - Start writing the code #9
2 Phase 1 - Fully Object Oriented #5
3 Phase 1 - Admin and User Interfac... #3
4 Report 29th #10
5 Phase 1- Random Access Binary F... #18
6 Phase 1 - Documentation #11
7 Phase 2- GUI using Webpages, HT... #6
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9 Github / Gantt - up to date #7
10 Time_Tracker_V1 #12
11 Time_Tracker_V2 #15
12 Time_Tracker_V3 #14
13 Time_Tracker_V4 #13
14 Time_Tracker_V5 #16
15 Time_Tracker_V6 #17
16 Time_Tracker_V7 #19
17 Time_Tracker_V8 #20
18 Time_Tracker_V9 #21
19 Time_Tracker_V9_1 #22
Add item
Phase 1 - Start writing the code #9
Phase 1 - Fully Object Oriented #5
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Report 29th #10
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Phase 1 - Documentation #11
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Time_Tracker_V1 #12
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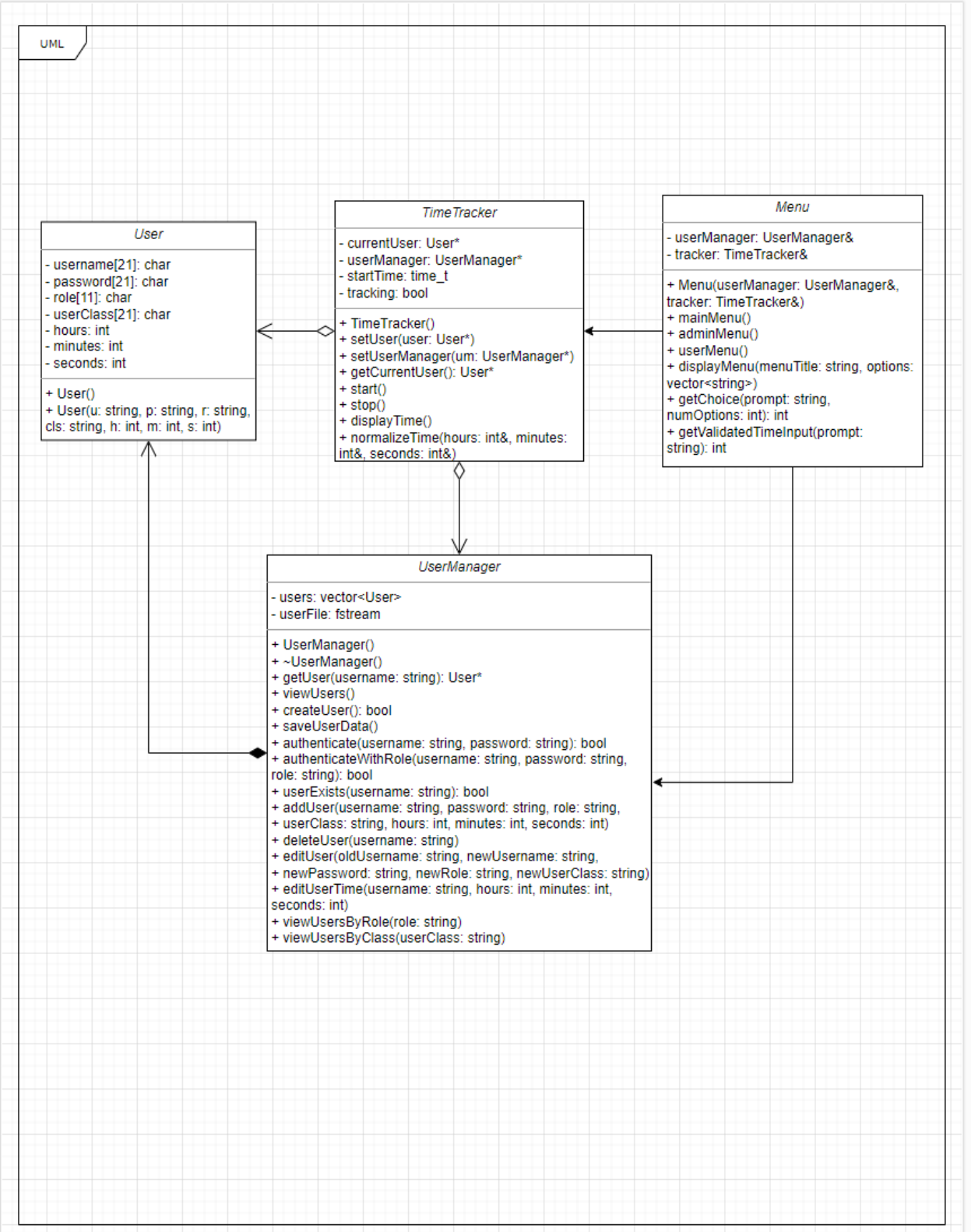
Time_Tracker_V5 #16
Time_Tracker_V6 #17
Time_Tracker_V7 #19
Time_Tracker_V8 #20
Time_Tracker_V9 #21
Time_Tracker_V9_1 #22

5. UML


UML
User
- username[21]: char
- password[21]: char
- role[11]: char
- userClass[21]: char
- hours: int
- minutes: int
- seconds: int
+ User()
+ User(u: string, p: string, r: string, cls: string, h: int, m: int, s: int)
TimeTracker
- currentUser: User*
- userManager: UserManager*
- startTime: time_t
- tracking: bool
+ TimeTracker()
+ setUser(user: User*)
+ setUserManager(um: UserManager*)
+ getCurrentUser(): User*
+ start()
+ stop()
+ displayTime()
+ normalizeTime(hours: int&, minutes: int&, seconds: int&)
Menu
- userManager: UserManager&
- tracker: TimeTracker&
+ Menu(userManager: UserManager&, tracker: TimeTracker&)
+ mainMenu()
+ adminMenu()
+ userMenu()
+ displayMenu(menuTitle: string, options: vector<string>)
+ getChoice(prompt: string, numOptions: int): int
+ getValidatedTimeInput(prompt: string): int
UserManager
- users: vector<User>
- userFile: fstream
+ UserManager()
+ ~UserManager()
+ getUser(username: string): User*
+ viewUsers()
+ createUser(): bool
+ saveUserData()
+ authenticate(username: string, password: string): bool
+ authenticateWithRole(username: string, password: string, role: string): bool
+ userExists(username: string): bool
+ addUser(username: string, password: string, role: string,
+ userClass: string, hours: int, minutes: int, seconds: int)
+ deleteUser(username: string)
+ editUser(oldUsername: string, newUsername: string,
+ newPassword: string, newRole: string, newUserClass: string)
+ editUserTime(username: string, hours: int, minutes: int, seconds: int)
+ viewUsersByRole(role: string)
+ viewUsersByClass(userClass: string)

6. Pseudo Code

Program TimeTrackerSystem

Class User

- Define properties for username, password, role, userClass, hours, minutes, seconds
- Initialize user properties with default values
- Provide constructors to set user properties

Class UserManager

- Define a list to store Users
- Define methods for user management:
  - Load users from file
  - Write users to file
  - Encrypt and decrypt user data
  - Get a user by username
  - Create a new user
  - Authenticate a user by username and password, and role
  - Check if a user exists
  - Add a user
  - Edit a user's details
  - Edit a user's time
  - Delete a user
  - View all users or filter by role or class

Class TimeTracker

- Define properties for currentUser, userManager, startTime, tracking status
- Methods for time tracking:
  - Start tracking time for the current user

Stop tracking and calculate elapsed time

Display the current logged time

Normalize time to handle overflow of minutes and seconds

Class Menu

Define properties for UserManager and TimeTracker

Display main menu and handle user interactions:

Main menu to choose between Admin and User login, account creation, and exit

Admin menu to manage users and their times

User menu for time tracking and editing own details

Validate time input to ensure correct time format

Main

Instantiate UserManager and TimeTracker

Initialize TimeTracker with UserManager

Display the main menu and process user commands until exit

End Program

7.Demonstrating Functionality

7.1 Proof of Concept

Menu.h

```
/**
 * @file Menu.h
 * @brief Defines the Menu class which manages user interactions and menu
navigation.
 * @author
 * @date May 3, 2024
 */

#ifndef MENU_H
#define MENU_H

#include "UserManager.h"
#include "TimeTracker.h"
#include <string>
using namespace std;

/**
 * @class Menu
 * @brief Handles the main menu and submenus for user interactions.
 *
 * This class is responsible for displaying different menus based on the
user type (admin/user) and managing the user's navigation through these
menus.
 */
class Menu {
public:
    /**
     * @brief Constructor for the Menu class.
     * @param userManager Reference to the UserManager to manage user data.
     * @param tracker Reference to the TimeTracker for tracking time.
     */
    Menu(UserManager& userManager, TimeTracker& tracker);

    /**
     * @brief Displays the main menu and handles user interactions.
     */
    void mainMenu();

private:
    UserManager& userManager; ///< UserManager object to manage user data.
    TimeTracker& tracker; ///< TimeTracker object to handle time tracking.

    void adminMenu(); ///< Displays the admin menu and handles admin
interactions.
    void userMenu(); ///< Displays the user menu and handles regular user
interactions.
```

```
    void displayMenu(const string& menuTitle, const vector<string>&
options); ///< Generic menu display function.
    int getChoice(const string& prompt, int numOptions); ///< Retrieves and
validates user menu choice.
    int getValidatedTimeInput(const string& prompt); ///< Ensures the user
inputs valid time data.
};

#endif // MENU_H
```

TimeTracker.h

```
/**
 * @file TimeTracker.h
 * @brief Defines the TimeTracker class for managing time tracking for
users.
 * @author alex
 * @date March 26, 2024
 */

#ifndef TIMETRACKER_H
#define TIMETRACKER_H

#include "User.h"
#include "UserManager.h"
#include <ctime>  // Includes standard time functions
#include <string>

/**
 * @class TimeTracker
 * @brief Manages the tracking of user time sessions.
 *
 * This class is responsible for starting, stopping, and displaying the time
tracking
 * of a user's session. It utilizes time_t to track the start time of a
session.
 */
class TimeTracker {
private:
    User* currentUser; ///< Pointer to the current user in session.
    UserManager* userManager; ///< Pointer to the UserManager to access user
management functions.
    time_t startTime; ///< Stores the start time of the current tracking
session using time_t instead of chrono.
    bool tracking; ///< Flag to check if time tracking is currently active.

    /**
     * @brief Normalizes the time to ensure minutes and seconds are within
typical range.
     * @param hours Reference to the hours to adjust.
```

```
     * @param minutes Reference to the minutes to adjust.
     * @param seconds Reference to the seconds to adjust.
     *
     * Ensures that seconds are less than 60 by rolling over excess into
minutes, and similarly for minutes to hours.
     */
    void normalizeTime(int& hours, int& minutes, int& seconds);

public:
    /**
     * @brief Constructor, initializes pointers to nullptr.
     */
    TimeTracker() : currentUser(nullptr), userManager(nullptr) {}

    /**
     * @brief Sets the current user for the time tracking session.
     * @param user Pointer to the user to be set as current user.
     */
    void setUser(User* user) { currentUser = user; }

    /**
     * @brief Sets the user manager handling the users.
     * @param um Pointer to the UserManager.
     */
    void setUserManager(UserManager* um) { userManager = um; }

    /**
     * @brief Gets the current user involved in the time tracking session.
     * @return Pointer to the current user.
     */
    User* getCurrentUser() const { return currentUser; }

    void start(); ///< Starts the time tracking session.
    void stop(); ///< Stops the current time tracking session.
    void displayTime(); ///< Displays the accumulated time for the current
session.
};

#endif // TIMETRACKER_H
```

User.h

```
/**
 * @file User.h
 * @brief Defines the User class for managing user details in the system.
 * @author alex
 * @date March 30, 2024
 */

#ifndef USER_H
#define USER_H

#include <cstring>  // Includes functions for memory manipulation
#include <string>
using namespace std;

/**
 * @class User
 * @brief Holds information about a system user, including credentials and
time logged.
 *
 * This class stores details such as username, password, role, class
information,
 * and the time duration for which the user has been active. It provides
constructors
 * for initializing these values.
 */
class User {
public:
    char username[21]; ///< Username of the user, fixed size to ensure data
consistency.
    char password[21]; ///< User's password, securely stored.
    char role[11]; ///< Role of the user (e.g., admin, student).
    char userClass[21]; ///< Class information, relevant for student users.
    int hours; ///< Hours part of the time logged by the user.
    int minutes; ///< Minutes part of the time logged by the user.
    int seconds; ///< Seconds part of the time logged by the user.

    /**
     * @brief Default constructor that initializes the user's properties to
zero or empty.
     *
     * Initializes numeric time values to zero and character arrays to empty
strings,
     * ensuring that all user properties start from a clean state.
     */
    User() : hours(0), minutes(0), seconds(0) {
        memset(username, 0, sizeof(username)); // Clear username array
        memset(password, 0, sizeof(password)); // Clear password array
        memset(role, 0, sizeof(role)); // Clear role array
        memset(userClass, 0, sizeof(userClass)); // Clear class information
array
```

```
    }

    /**
     * @brief Parameterized constructor for creating a user with detailed
information.
     * @param u Username of the user.
     * @param p Password of the user.
     * @param r Role of the user.
     * @param cls Class of the user, optional with default empty.
     * @param h Hours logged, optional with default 0.
     * @param m Minutes logged, optional with default 0.
     * @param s Seconds logged, optional with default 0.
     *
     * This constructor initializes the user with provided details, ensuring
     * that string lengths are handled correctly to fit into fixed-size
character arrays.
     */
    User(string u, string p, string r, string cls = "", int h = 0, int m =
0, int s = 0) {
        strncpy(username, u.c_str(), 20); // Copy username, ensuring it does
not exceed buffer size
        username[20] = '\0'; // Null terminate username array
        strncpy(password, p.c_str(), 20); // Copy password similarly
        password[20] = '\0'; // Null terminate password array
        strncpy(role, r.c_str(), 10); // Copy role
        role[10] = '\0'; // Null terminate role array
        strncpy(userClass, cls.c_str(), 20); // Copy class information
        userClass[20] = '\0'; // Null terminate class array
        hours = h; // Set hours
        minutes = m; // Set minutes
        seconds = s; // Set seconds
    }
};

#endif // USER_H
```

UserManager.h

```
/**
 * @file UserManager.h
 * @brief Defines the UserManager class for managing user accounts and
interactions with user data files.
 * @author alex
 * @date March 30, 2024
 */

#ifndef USERMANAGER_H
#define USERMANAGER_H

#include "User.h"
#include <vector>
```

```cpp
#include <fstream>
#include <sstream>
using namespace std;

/**
 * @class UserManager
 * @brief Manages user operations such as authentication, user data
retrieval, and user data persistence.
 *
 * Handles user-related tasks including adding, deleting, and editing users,
as well as
 * authentication and viewing user details. It interfaces with a file system
to persist user data.
 */
class UserManager {
private:
    vector<User> users; ///< Container for storing all user objects in
memory.
    fstream userFile; ///< File stream for user data file operations.

    void loadUsers(); ///< Loads users from the file into the vector.
    void writeUsersToFile(); ///< Writes the user data from the vector back
into the file.
    /**
     * @brief Encrypts user data using XOR encryption.
     * @param user User object to encrypt.
     */
    void encryptUser(User& user); ///< Encrypts user data to ensure privacy.

    /**
     * @brief Decrypts user data using XOR decryption.
     * @param user User object to decrypt.
     */
    void decryptUser(User& user); ///< Decrypts user data to make it
readable.

public:
    UserManager(); ///< Constructor that initializes and loads users from a
file.
    ~UserManager(); ///< Destructor that ensures any remaining user data is
saved.

    /**
     * @brief Retrieves a user object by username.
     * @param username The username of the user to retrieve.
     * @return Pointer to the User object if found, nullptr otherwise.
     */
    User* getUser(const string& username);

    void viewUsers(); ///< Displays all users' information.
    bool createUser(); ///< Interactively creates a new user from console
input.
    void saveUserData(); ///< Saves all user data to the file.
```

```
    /**
     * @brief Authenticates a user based on username and password.
     * @param username The username to authenticate.
     * @param password The password to authenticate.
     * @return True if authentication is successful, false otherwise.
     */
    bool authenticate(string username, string password);

    /**
     * @brief Authenticates a user with an additional role check.
     * @param username The username to authenticate.
     * @param password The password to authenticate.
     * @param role The role to validate against.
     * @return True if authentication and role check are successful, false
otherwise.
     */
    bool authenticateWithRole(const string& username, const string&
password, const string& role);

    /**
     * @brief Checks if a user exists by username.
     * @param username The username to check.
     * @return True if the user exists, false otherwise.
     */
    bool userExists(const string& username);

    /**
     * @brief Adds a new user with detailed information.
     * @param username The new user's username.
     * @param password The new user's password.
     * @param role The new user's role.
     * @param userClass The class information, relevant for students.
     * @param hours Initial hours logged, optional.
     * @param minutes Initial minutes logged, optional.
     * @param seconds Initial seconds logged, optional.
     */
    void addUser(string username, string password, string role, string
userClass, int hours = 0, int minutes = 0, int seconds = 0);

    /**
     * @brief Deletes a user by username.
     * @param username The username of the user to delete.
     */
    void deleteUser(string username);

    /**
     * @brief Edits existing user details.
     * @param oldUsername The current username of the user.
     * @param newUsername The new username, if changing.
     * @param newPassword The new password, if changing.
     * @param newRole The new role, if changing.
     * @param newUserClass The new class information, if applicable.
```

```
     */
    void editUser(string oldUsername, string newUsername, string
newPassword, string newRole = "", string newUserClass = "");

    /**
     * @brief Edits the time logged for a specific user.
     * @param username The username of the user whose time is being edited.
     * @param hours The new hours to set.
     * @param minutes The new minutes to set.
     * @param seconds The new seconds to set.
     */
    void editUserTime(const string& username, int hours, int minutes, int
seconds);

    /**
     * @brief Views users filtered by their role.
     * @param role The role to filter users by (e.g., "student",
"instructor").
     */
    void viewUsersByRole(const string& role);

    /**
     * @brief Views users filtered by their class.
     * @param userClass The class to filter users by.
     */
    void viewUsersByClass(const string& userClass);
};

#endif // USERMANAGER_H
```

Menu.cpp

```
/**
 * @file Menu.cpp
 * @brief Implementation for the Menu class which handles all menu-driven
interactions.
 * @author Aleksandar Videv
 * @date May 3, 2024
 */
#include "TimeTracker.h"
#include "Menu.h"
#include <iostream>
#include <string>
#include <vector>
#include <sstream> // Required for istringstream
#include <iomanip> // Required for get_time

using namespace std;

/**
```

```
 * @brief Constructs the Menu object.
 * @param userManager A reference to UserManager to manage user data.
 * @param tracker A reference to TimeTracker to manage time tracking.
 */
Menu::Menu(UserManager& userManager, TimeTracker& tracker) :
userManager(userManager), tracker(tracker) {}

/**
 * @brief Displays the main menu and handles user input for various
functionalities.
 */
void Menu::mainMenu() {
    string input;
    bool exit = false;

    // Loop until the user chooses to exit the program
    while (!exit) {
        cout << "\nMain Menu\n"
             << "1. Admin Login\n"
             << "2. User Login\n"
             << "3. Create Account\n"
             << "4. Exit\n"
             << "Enter choice: ";
        getline(cin, input);

        // Handle user choice using a switch statement
        switch (input[0]) {
            case '1': // Admin login
            case '2': // User login
                {
                    string username, password;
                    cout << (input[0] == '1' ? "Admin" : "User") << "
Login\n"
                         << "Enter username: ";
                    getline(cin, username);
                    cout << "Enter password: ";
                    getline(cin, password);

                    // Authenticate user based on role (admin or user)
                    bool isAuthenticated =
userManager.authenticateWithRole(username, password, input[0] == '1' ?
"instructor" : "student");
                    if (isAuthenticated) {
                        // Fetch user details and set in tracker if
authenticated
                        User* loggedInUser = userManager.getUser(username);
                        tracker.setUser(loggedInUser);

                        // Redirect to appropriate menu based on role
                        if (input[0] == '1') {
                            adminMenu();  // Access admin-specific functions
                        } else {
                            userMenu();   // Access general user functions
```

```
                        }
                    } else {
                        cout << "Incorrect credentials or access level.\n";
                    }
                    break;
                }
            case '3': // Create Account
                // Initiate user creation process
                userManager.createUser();
                break;
            case '4': // Exit
                // Set flag to true to exit loop and end the program
                cout << "Exiting program.\n";
                exit = true;
                break;
            default:
                // Handle unexpected input
                cout << "Invalid choice. Please try again.\n";
        }
    }
}

/**
 * @brief Displays the administrative menu for admin operations like user
management.
 */
void Menu::adminMenu() {
    string choice;
    do {
        cout << "\nAdmin Menu\n"
             << "1. View Users\n"
             << "2. Add User\n"
             << "3. Delete User\n"
             << "4. Edit User\n"
             << "5. Edit User Time\n"
             << "0. Exit to Main Menu\n"
             << "Enter choice: ";
        getline(cin, choice);
        cout << endl;

        // Handle the choice for different administrative tasks
        switch (choice[0]) {
            case '1': // View Users
                cout << "1. View All Users\n"
                     << "2. View by Role\n"
                     << "3. View by Class\n"  // Added option to view by
class
                     << "Enter choice for view: ";
                getline(cin, choice);
                if (choice == "1") {
                    userManager.viewUsers();
                } else if (choice == "2") {
                    cout << "Choose role (s = Student, i = Instructor): ";
```

```
                    string role;
                    getline(cin, role);
                    userManager.viewUsersByRole(role);  // View users by
normalized role
                } else if (choice == "3") {
                    cout << "Enter class to filter by: ";  // Prompt for
class
                    string userClass;
                    getline(cin, userClass);
                    userManager.viewUsersByClass(userClass);  // View users
by class
                }
                break;
            case '2': // Add User
                userManager.createUser();
                break;
            case '3': // Delete User
                {
                    string username;
                    cout << "Enter username to delete: ";
                    getline(cin, username);
                    userManager.deleteUser(username);
                    if (userManager.userExists(username)) {
                       cout << "User deleted successfully.\n";
                    }
                }
                break;
            case '4': //Edit User
                {
                string username, newUsername, newPassword, newRole,
newUserClass;
                char roleChoice;
                cout << "Enter username to edit: ";
                getline(cin, username);

                if (!userManager.userExists(username)) {
                    cout << "User not found.\n";
                    break;
                }
                cout << "Enter new username (leave empty if unchanged): ";
                getline(cin, newUsername);
                cout << "Enter new password (leave empty if unchanged): ";
                getline(cin, newPassword);

                // Adding a choice for the role
                cout << "Choose new role (1 for Student, 2 for Instructor,
leave empty if unchanged): ";
                getline(cin, newRole);
                bool promptForClass = false;
                if (!newRole.empty()) {
                    roleChoice = newRole[0];
                    switch (roleChoice) {
                        case '1':
```

```
                            newRole = "student";
                            promptForClass = true; // Prompt for class if
role is student
                            break;
                        case '2':
                            newRole = "instructor";
                            newUserClass = ""; // Clear class when role is
instructor
                            break;
                        default:
                            cout << "Invalid role selected. No changes to
role will be made.\n";
                            newRole = ""; // Reset to empty to avoid
changing the role
                            promptForClass = true; // Still prompt for class
if the role change is invalid
                            break;
                    }
                }

                // Prompt for class if role is student or role change is
skipped
                if (promptForClass) {
                    cout << "Enter new class (leave empty if unchanged): ";
                    getline(cin, newUserClass);
                }

                userManager.editUser(username, newUsername, newPassword,
newRole, newUserClass);
            }
                break;
            case '5': // Edit User Time
               {
                   string username;
                   cout << "Enter username of the user to edit time: ";
                   getline(cin, username);

                   // Check if user exists before asking for time details
                   if (!userManager.userExists(username)) {
                       cout << "User not found.\n";
                       break;  // Exit if user doesn't exist
                   }

                   int hours = getValidatedTimeInput("Enter new hours (0-
9999): ");
                   int minutes = getValidatedTimeInput("Enter new minutes
(0-59): ");
                   int seconds = getValidatedTimeInput("Enter new seconds
(0-59): ");

                   userManager.editUserTime(username, hours, minutes,
seconds);
               }
```

```
                break;
            case '0':
                return; // Exit admin menu
            default:
                cout << "Invalid choice. Please try again.\n";
        }
    } while (true);
}

/**
 * @brief Displays the user menu for regular user functions.
 */
void Menu::userMenu() {
    string choice;
    // Continuously display the menu until the user decides to exit
    do {
        cout << "\nUser Menu\n"
             << "1. Start Timer\n"
             << "2. Stop Timer\n"
             << "3. Display Logged Time\n"
             << "4. Edit Details\n"
             << "0. Exit to Main Menu\n"
             << "Enter choice: ";
        getline(cin, choice);

        // Handle the user's menu selection
        switch (choice[0]) {
            case '1':
                // Starts the time tracking for the current session
                tracker.start();
                break;
            case '2':
                // Stops the time tracking and logs the session duration
                tracker.stop();
                break;
            case '3':
                // Displays the total time logged in the current session
                tracker.displayTime();
                break;
            case '4':
                {
                    // Attempts to retrieve the current logged-in user
                    User* user = tracker.getCurrentUser();
                    if (user) {
                        string newUsername, newPassword;
                        cout << "Enter new username (leave empty if
unchanged): ";
                        getline(cin, newUsername);
                        cout << "Enter new password (leave empty if
unchanged): ";
                        getline(cin, newPassword);
                        // Submits the updated user details to the
UserManager
```

```
                        userManager.editUser(user->username, newUsername,
newPassword);
                    } else {
                        // Notifies if no user is currently logged in
                        cout << "No user logged in.\n";
                    }
                }
                break;
            case '0':
                // Exits the user menu and returns to the main menu
                return;
            default:
                // Handles invalid choices entered by the user
                cout << "Invalid choice. Please try again.\n";
        }
    } while (true);
}

/**
 * @brief Prompts the user for time input and validates it.
 * @param prompt The prompt displayed to the user asking for input.
 * @return The validated time entered by the user.
 */
int Menu::getValidatedTimeInput(const string& prompt) {
    string input;
    int time;

    // Loop indefinitely until a valid time is entered
    while (true) {
        cout << prompt;
        getline(cin, input); // Read input from user

        try {
            time = stoi(input); // Attempt to convert the user input to an
integer

            // Check if the input falls within the valid range for hours or
minutes/seconds
            if (prompt.find("hours") != string::npos && time >= 0 && time <=
9999) {
                // If the prompt is for hours and the value is within the
valid range, break the loop
                break;
            } else if (time >= 0 && time <= 59) {
                // If the prompt is for minutes/seconds and the value is
within the valid range, break the loop
                break;
            } else {
                // If the input is not within any valid range, prompt the
user again
                cout << "Invalid time. Please enter a valid number within
the range.\n";
            }
```

```
        } catch (const invalid_argument& e) {
            // Handle cases where conversion to integer fails
            cout << "Invalid input. Please enter a valid number.\n";
        } catch (const out_of_range& e) {
            // Handle cases where the integer is out of the acceptable range
            cout << "Number out of range. Please enter a smaller number.\n";
        }
    }

    return time; // Return the validated time value
}
```

TimeTracker.cpp

```
/**
 * @file TimeTracker.cpp
 * @brief Manages the tracking of time for users, including starting,
stopping, and displaying logged time.
 * @author alex
 * @date March 26, 2024
 */

#include "TimeTracker.h"
#include <iostream>
#include <ctime>

using namespace std;

/**
 * @brief Starts the timer for the current user session.
 *
 * This function records the start time if no timer is currently running and
a user is logged in.
 * If the timer is already running or no user is logged in, it outputs an
appropriate message.
 */
void TimeTracker::start() {
    if (!currentUser) {
        // Check if a user is logged in before starting the timer
        cout << "No user logged in.\n";
        return;
    }
    if (tracking) {
        // Prevent starting a new timer if one is already running
        cout << "Error: Timer is already running.\n";
        return;
    }
    startTime = time(nullptr); // Capture the current time as the start time
    tracking = true; // Set tracking to true to indicate the timer is
running
```

```
    cout << "Timer started.\n";
}


/**
 * @brief Stops the timer and logs the time elapsed since it was started.
 *
 * If the timer is running and a user is logged in, this function calculates
the elapsed time, updates the user's
 * time record, and saves the changes. If no timer is running or no user is
logged in, it outputs an error message.
 */
void TimeTracker::stop() {
    if (!tracking || !currentUser) {
        // Ensure that a timer is running and a user is logged in before
stopping the timer
        cout << "Timer not started or no user logged in.\n";
        return;
    }

    time_t endTime = time(nullptr); // Capture the current time as the end
time
    double elapsed_seconds = difftime(endTime, startTime); // Calculate
elapsed time in seconds
    int elapsedHours = static_cast<int>(elapsed_seconds) / 3600;
    int elapsedMinutes = (static_cast<int>(elapsed_seconds) / 60) % 60;
    int elapsedSeconds = static_cast<int>(elapsed_seconds) % 60;

    // Update the user's logged time
    currentUser->hours += elapsedHours;
    currentUser->minutes += elapsedMinutes;
    currentUser->seconds += elapsedSeconds;

    // Normalize the time to ensure proper time format
    normalizeTime(currentUser->hours, currentUser->minutes, currentUser-
>seconds);

    userManager->saveUserData(); // Save the updated user data
    tracking = false; // Set tracking to false as the timer is stopped

    cout << "Timer stopped. Time logged: "
         << elapsedHours << "h " << elapsedMinutes << "m " << elapsedSeconds
<< "s\n";
}


/**
 * @brief Displays the total logged time for the current user.
 *
 * Outputs the total time logged by the user both from past sessions and any
ongoing session.
 * If no user is logged in, it outputs an error message.
 */
```

```
void TimeTracker::displayTime() {
    if (!currentUser) {
        // Check if a user is logged in before displaying time
        cout << "No user logged in.\n";
        return;
    }

    int displayHours = currentUser->hours;
    int displayMinutes = currentUser->minutes;
    int displaySeconds = currentUser->seconds;

    if (tracking) {
        // Calculate additional time if the timer is currently running
        time_t currentTime = time(nullptr);
        double elapsed_seconds = difftime(currentTime, startTime);

        displaySeconds += static_cast<int>(elapsed_seconds) % 60;
        displayMinutes += (static_cast<int>(elapsed_seconds) / 60) % 60;
        displayHours += static_cast<int>(elapsed_seconds) / 3600;

        // Normalize time to handle overflow from seconds to minutes and
minutes to hours
        normalizeTime(displayHours, displayMinutes, displaySeconds);
    }
    // Output the total time logged for the user, including the current
session if applicable
    cout << "Logged Time: " << displayHours << "h " << displayMinutes << "m
" << displaySeconds << "s\n";
}

/**
 * @brief Normalizes the time values, rolling over seconds to minutes and
minutes to hours.
 *
 * Ensures that seconds and minutes do not exceed their maximum values by
converting excess into the next highest unit.
 * @param hours Reference to the hours to be normalized.
 * @param minutes Reference to the minutes to be normalized.
 * @param seconds Reference to the seconds to be normalized.
 */

void TimeTracker::normalizeTime(int& hours, int& minutes, int& seconds) {
    minutes += seconds / 60; // Convert excess seconds into minutes
    seconds %= 60; // Keep the remainder of seconds after dividing by 60
    hours += minutes / 60; // Convert excess minutes into hours
    minutes %= 60; // Keep the remainder of minutes after dividing by 60
}
```

UserManager.cpp

```
/*
```

```
 * @file UserManager.cpp
 * @brief Implementation of the UserManager class that handles user
management tasks like adding,
 *        deleting, and editing users, as well as loading and saving user
data to a file.
 * @author alex
 * @date March 30 , 2024, 7:23 AM
 */

#include "UserManager.h"
#include <iostream>
#include <fstream>
#include <sstream>
#include <algorithm>  // Include for remove_if
#include <cstring>  // for strlen, memset

using namespace std;


/**
 * @brief Destructor for UserManager.
 *
 * Ensures all user data is saved before the object is destroyed.
 */
UserManager::~UserManager() {
    saveUserData(); // Save any remaining data.
}

/**
 * @brief Constructor for UserManager.
 *
 * Opens the users.dat file or creates it if it does not exist, then loads
existing user data.
 */
UserManager::UserManager() {
    userFile.open("users.dat", ios::binary | ios::in | ios::out | ios::ate);
// Attempt to open an existing file.
    if (!userFile.is_open()) {
        std::cerr << "Failed to open users.dat. Attempting to create a new
file." << std::endl;
        userFile.clear(); // Clear any error flags.
        userFile.open("users.dat", ios::binary | ios::out | ios::trunc); //
Create a new file.
        userFile.close(); // Close the newly created file.
        userFile.open("users.dat", ios::binary | ios::in | ios::out); //
Reopen with read/write permissions.
    }
    if (!userFile) {
        std::cerr << "Error: Unable to open or create the users file!" <<
std::endl;
        exit(1); // Exit if still unable to open or create the file.
    }
    loadUsers(); // Load users from the file.
```

```
}

/**
 * @brief Save user data to the file.
 *
 * This method encrypts each user's data and writes it to the binary file.
 * If the file is not open, it outputs an error message.
 */
void UserManager::saveUserData() {
    if (userFile.is_open()) {
        userFile.seekp(0); // Start writing from the beginning of the file.
        userFile.clear(); // Clear any error flags that might be set.

        for (User& user : users) {
            encryptUser(user);  // Encrypt the user data.
            userFile.write(reinterpret_cast<const char*>(&user),
sizeof(User));  // Write the encrypted data to the file.
            decryptUser(user);  // Decrypt the user data to restore original
values.
        }

        userFile.flush(); // Ensure all data is written to the disk.
    } else {
        cerr << "File not open for writing." << endl;  // Error handling if
file isn't open.
    }
}

/**
 * @brief Encrypts user data using XOR encryption.
 *
 * @param user Reference to user object to be encrypted.
 */
void UserManager::encryptUser(User& user) {
    char key = 'K'; // Encryption key, simple for demonstration.
    for (size_t i = 0; i < sizeof(User); ++i) {
        reinterpret_cast<char*>(&user)[i] ^= key;  // Apply XOR for each
byte of user data.
    }
}

/**
 * @brief Decrypts user data.
 *
 * This function uses the same encryptUser function to decrypt because XOR
is its own inverse.
 * @param user Reference to user object to be decrypted.
 */
void UserManager::decryptUser(User& user) {
    encryptUser(user); // Decrypt by re-applying the XOR encryption.
}

/**
```

```
 * @brief Writes encrypted users data to a file.
 *
 * This method handles the file operations required to write all user data
after encrypting it.
 */
void UserManager::writeUsersToFile() {
    userFile.close();  // Ensure the file is not already open.
    userFile.open("users.dat", ios::binary | ios::out | ios::trunc);  //
Open file in binary mode to write from scratch.

    if (!userFile.is_open()) {
        std::cerr << "Failed to open file for writing." << std::endl;
        return;
    }

    for (auto& user : users) {
        encryptUser(user);  // Encrypt each user's data.
        userFile.write(reinterpret_cast<const char*>(&user), sizeof(User));
// Write the encrypted data.
        decryptUser(user);  // Decrypt the data to retain the original state
in memory.
    }

    userFile.flush();  // Flush the stream to ensure all data is written.
    userFile.close();  // Close the file after writing.
    userFile.open("users.dat", ios::binary | ios::in | ios::out);  // Reopen
file for both reading and writing.
}

/**
 * @brief Loads users data from a file.
 *
 * This function reads encrypted user data from a file, decrypts it, and
adds it to the users vector.
 * If the file fails to open, it prints an error message.
 */
void UserManager::loadUsers() {
    std::ifstream file("users.dat", ios::binary); // Open the file in binary
read mode.

    if (!file) {
        std::cerr << "Failed to open file for reading." << std::endl; //
Error handling if file isn't open.
        return;
    }

    User user;
    while (file.read(reinterpret_cast<char*>(&user), sizeof(User))) {
        decryptUser(user);  // Decrypt user data after reading from the
file.
        users.push_back(user);  // Add the decrypted user to the vector of
users.
    }
```

```
    file.close();  // Close the file after all users have been read.
}

/**
 * @brief Retrieves a user object by username.
 *
 * Searches for a user by username in the list of users. Returns a pointer
to the User object if found,
 * otherwise returns nullptr.
 * @param username The username of the user to find.
 * @return A pointer to the User object or nullptr if not found.
 */
User* UserManager::getUser(const string& username) {
    for (auto& user : users) {
        if (strcmp(user.username, username.c_str()) == 0) {
            return &user;  // Return the address of the user if found
        }
    }
    return nullptr;  // Return nullptr if no user is found
}

/**
 * @brief Edits the time logged for a specific user.
 *
 * First normalizes the provided time values (hours, minutes, and seconds)
and then updates the
 * specified user's logged time if they exist in the system.
 * @param username The username of the user whose time needs updating.
 * @param hours The number of hours to set.
 * @param minutes The number of minutes to set.
 * @param seconds The number of seconds to set.
 */
void UserManager::editUserTime(const string& username, int hours, int
minutes, int seconds) {
    // Normalize the entered time first
    minutes += seconds / 60;
    seconds %= 60;
    hours += minutes / 60;
    minutes %= 60;

    // Check if the user exists and update their time
    for (auto& user : users) {
        if (user.username == username) {
            user.hours = hours;
            user.minutes = minutes;
            user.seconds = seconds;
            writeUsersToFile(); // Save changes to file
            cout << "User time updated successfully.\n";
            return;  // Exit the function after successful update
        }
    }
    cout << "User not found. No time updated.\n";  // Notify if user not
found
```

```
}


/**
 * @brief Authenticates a user with a specific role.
 *
 * Checks if there exists a user with the given username, password, and
role.
 * @param username The username of the user.
 * @param password The password of the user.
 * @param role The role of the user.
 * @return True if such a user exists, otherwise false.
 */
bool UserManager::authenticateWithRole(const string& username, const string&
password, const string& role) {
    for (const auto& user : users) {
        if (strcmp(user.username, username.c_str()) == 0 &&
            strcmp(user.password, password.c_str()) == 0 &&
            strcmp(user.role, role.c_str()) == 0) {
            return true;  // User found and matches all credentials
        }
    }
    return false;  // No matching user found
}

/**
 * @brief Checks if a user exists based on username.
 *
 * Searches for a user in the list by the username.
 * @param username The username to check against the user list.
 * @return True if the user exists, otherwise false.
 */
bool UserManager::userExists(const string& username) {
    return any_of(users.begin(), users.end(), [&username](const User& user)
{
        return strcmp(user.username, username.c_str()) == 0;  // Compare the
current user's username with the given one
    });
}

/**
 * @brief Displays all registered users along with their details.
 *
 * Lists every user's username, role, class (if applicable), and time
logged. It only displays
 * class and time for students.
 */
void UserManager::viewUsers() {
    if (users.empty()) {
        cout << "No users available.\n";  // Inform if no users are
registered
        return;
    }
```

```
    for (const auto& user : users) {
        cout << "Username: " << user.username << ", Role: " << user.role;
        if (strcmp(user.role, "student") == 0) {
            cout << ", Class: " << user.userClass;  // Display class
information if the user is a student
            cout << ", Time: " << user.hours << "h " << user.minutes << "m "
<< user.seconds << "s";
        }
        cout << "\n";
    }
}

/**
 * @brief Filters and displays users by their role.
 *
 * Allows viewing of users grouped by a specified role such as 'student' or
'instructor'.
 * @param inputRole The role to filter the users by.
 */
void UserManager::viewUsersByRole(const string& inputRole) {
    string role;
    // Normalize input to handle different case inputs and partial inputs
    if (inputRole == "s" || inputRole == "S" || inputRole == "student" ||
inputRole == "Student" || inputRole == "STUDENT") {
        role = "student";
    } else if (inputRole == "i" || inputRole == "I" || inputRole ==
"instructor" || inputRole == "Instructor" || inputRole == "INSTRUCTOR") {
        role = "instructor";
    } else {
        cout << "Invalid role input. Please enter 's' for Student or 'i' for
Instructor.\n";
        return;
    }

    bool found = false;
    for (const auto& user : users) {
        if (user.role == role) {
            found = true;
            cout << "Username: " << user.username << ", Role: " <<
user.role;
            if (role == "student") {
                cout << ", Class: " << user.userClass;  // Display class if
student
            }
            cout << ", Time: " << user.hours << "h " << user.minutes << "m "
<< user.seconds << "s\n";
        }
    }
    if (!found) {
        cout << "No users found with role " << role << ".\n";  // Inform if
no users are found with the specified role
    }
}
```

```
/**
 * @brief Filters and displays users by their class.
 *
 * Allows viewing of users grouped by a specified class, typically
applicable to students.
 * @param userClass The class to filter the users by.
 */
void UserManager::viewUsersByClass(const string& userClass) {
    bool found = false;
    for (const auto& user : users) {
        if (user.userClass == userClass) {
            found = true;
            cout << "Username: " << user.username << ", Class: " <<
user.userClass
                 << ", Role: " << user.role << ", Time: "
                 << user.hours << "h " << user.minutes << "m " <<
user.seconds << "s\n";
        }
    }
    if (!found) {
        cout << "No users found in class " << userClass << ".\n"; // Notify
if no users are found in the specified class
    }
}

/**
 * @brief Adds a new user to the system if they do not already exist.
 *
 * Creates a new user with specified details and saves them to the system,
ensuring no username duplication.
 * @param username The username for the new user.
 * @param password The password for the new user.
 * @param role The role of the new user (e.g., student, instructor).
 * @param userClass The class of the new user, relevant for students.
 * @param hours Initial hours logged (optional).
 * @param minutes Initial minutes logged (optional).
 * @param seconds Initial seconds logged (optional).
 */
void UserManager::addUser(string username, string password, string role,
string userClass, int hours, int minutes, int seconds) {
    if (!userExists(username)) {
        User newUser(username, password, role, userClass, hours, minutes,
seconds);
        users.push_back(newUser);
        writeUsersToFile(); // Persist the new user data
    } else {
        cout << "An account with that username already exists.\n";  //
Notify if the username is already taken
    }
}

/**
```

```
 * @brief Interactively creates a new user based on console input.
 *
 * Prompts for and receives user details from the console, then adds the
user to the system if the username is not taken.
 * @return True if the user was created successfully, otherwise false.
 */
bool UserManager::createUser() {
    string username, password, role, userClass, input;

    cout << "Create a new account.\n";
    cout << "Enter username: ";
    getline(cin, username);
    if (userExists(username)) {
        cout << "An account with that username already exists. Please choose
a different username.\n";
        return false;
    }

    cout << "Enter password: ";
    getline(cin, password);
    cout << "Enter role (S for Student, I for Instructor): ";
    getline(cin, input);
    char roleChoice = input.length() > 0 ? input[0] : ' ';
    switch (roleChoice) {
        case 'S':
        case 's':
            role = "student";
            cout << "Enter class: ";
            getline(cin, userClass);  // Prompt for class if the role is
student
            break;
        case 'I':
        case 'i':
            role = "instructor";
            break;
        default:
            cout << "Invalid role. Only 'S' for Student or 'I' for
Instructor are allowed.\n";
            return false;
    }

    addUser(username, password, role, userClass);  // Add the new user
    cout << "Account successfully created as " << role << ".\n";
    return true;
}

/**
 * @brief Edits an existing user's details.
 *
 * Allows modification of username, password, role, and class based on
provided inputs. Ensures the new username is not already taken.
 * @param oldUsername The current username of the user to be edited.
 * @param newUsername The new username to update to, if provided.
```

```
 * @param newPassword The new password to update to, if provided.
 * @ant'semail.comwRole The new role to update to, if provided.
 * @param newUserClass The new class to update to, if applicable.
 */
void UserManager::editUser(string oldUsername, string newUsername, string
newPassword, string newRole, string newUserClass) {
    for (auto& user : users) {
        if (strcmp(user.username, oldUsername.c_str()) == 0) {
            if (!newUsername.empty() && !userExists(newUsername)) {
                strncpy(user.username, newUsername.c_str(), 20);  // Update
username if new one is not taken
                user.username[20] = '\0';
            }
            if (!newPassword.empty()) {
                strncpy(user.password, newPassword.c_str(), 20);  // Update
password
                user.password[20] = '\0';
            }
            if (!newRole.empty()) {
                strncpy(user.role, newRole.c_str(), 10);  // Update role
                user.role[10] = '\0';
            }
            if (!newUserClass.empty()) {
                strncpy(user.userClass, newUserClass.c_str(), 20);  //
Update class for students
                user.userClass[20] = '\0';
            }
            writeUsersToFile();  // Persist changes to disk
            cout << "User details updated successfully.\n";
            return;
        }
    }
    cout << "User not found. No changes made.\n";  // Notify if the
specified user does not exist
}

/**
 * @brief Deletes a user from the system.
 *
 * Removes a user with the specified username from the list and updates the
user file.
 * @param username The username of the user to delete.
 */
void UserManager::deleteUser(string username) {
    auto it = remove_if(users.begin(), users.end(), [&username](const User&
user) {
        return username == user.username;  // Find the user to delete
    });

    if (it != users.end()) {
        users.erase(it, users.end());  // Remove the user from the list
        writeUsersToFile();  // Update the file after removal
        cout << "User deleted successfully." << endl;
```

```
    } else {
        cout << "User not found. No user deleted." << endl;
    }
}
```

Main.cpp

```
/**
 * @file main.cpp
 * @brief Entry point for the Time Tracker application.
 *
 * Initializes the main components of the application including UserManager,
TimeTracker, and Menu.
 * It sets up the relationships between these components and starts the user
interaction process through the main menu.
 * @author Aleksandar Videv
 * @date March 12, 2024
 */

#include "Menu.h"
#include "UserManager.h"
#include "TimeTracker.h"

/**
 * @brief The main function that serves as the entry point of the
application.
 *
 * Sets up the user manager and time tracker, links them together, and
launches the main menu.
 * @return Returns 0 upon successful completion.
 */
int main() {
    UserManager userManager;  // Instantiate the UserManager to manage user
data.
    TimeTracker tracker;      // Create a TimeTracker to handle timing
functionality.
    tracker.setUserManager(&userManager);  // Associate the UserManager with
the TimeTracker.

    Menu menu(userManager, tracker);  // Create the main Menu with
references to userManager and tracker.
    menu.mainMenu();  // Display the main menu and handle user interactions.

    return 0;  // Return 0 to indicate successful completion of the program.
}
```

7.2 Testing Results

```
Main Menu
1. Admin Login
2. User Login
3. Create Account
4. Exit
Enter choice: 1
Admin Login
Enter username: alex
Enter password: alex
Incorrect credentials or access level.

Main Menu
1. Admin Login
2. User Login
3. Create Account
4. Exit
Enter choice: 3
Create a new account.
Enter username: alex
Enter password: alex
Enter role (S for Student, I for Instructor): i
Account successfully created as instructor.

Main Menu
1. Admin Login
2. User Login
3. Create Account
4. Exit
Enter choice: 3
Create a new account.
Enter username: jake
Enter password: 123
Enter role (S for Student, I for Instructor): s
Enter class: cis12
Account successfully created as student.

Main Menu
1. Admin Login
2. User Login
3. Create Account
4. Exit
Enter choice: 1
Admin Login
Enter username: alex
Enter password: alex

Admin Menu
1. View Users
2. Add User
3. Delete User
```

```
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 1

1. View All Users
2. View by Role
3. View by Class
Enter choice for view: 1
Username: z, Role: student, Class: 12, Time: 0h 0m 0s
Username: a, Role: instructor
Username: x, Role: student, Class: 1, Time: 0h 0m 0s
Username: alex, Role: instructor
Username: jake, Role: student, Class: cis12, Time: 0h 0m 0s

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 1

1. View All Users
2. View by Role
3. View by Class
Enter choice for view: 2
Choose role (s = Student, i = Instructor): s
Username: z, Role: student, Class: 12, Time: 0h 0m 0s
Username: x, Role: student, Class: 1, Time: 0h 0m 0s
Username: jake, Role: student, Class: cis12, Time: 0h 0m 0s

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 3

Enter username to delete: z
User deleted successfully.

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 1
```

```
1. View All Users
2. View by Role
3. View by Class
Enter choice for view: 1
Username: a, Role: instructor
Username: x, Role: student, Class: 1, Time: 0h 0m 0s
Username: alex, Role: instructor
Username: jake, Role: student, Class: cis12, Time: 0h 0m 0s

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 4

Enter username to edit: x
Enter new username (leave empty if unchanged): Bob
Enter new password (leave empty if unchanged): bob123
Choose new role (1 for Student, 2 for Instructor, leave empty if unchanged):
1
Enter new class (leave empty if unchanged): cis3
User details updated successfully.

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 1

1. View All Users
2. View by Role
3. View by Class
Enter choice for view: 1
Username: a, Role: instructor
Username: Bob, Role: student, Class: cis3, Time: 0h 0m 0s
Username: alex, Role: instructor
Username: jake, Role: student, Class: cis12, Time: 0h 0m 0s

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 3
```

```
Enter username to delete: a
User deleted successfully.

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 1

1. View All Users
2. View by Role
3. View by Class
Enter choice for view: 3
Enter class to filter by: cis3
Username: Bob, Class: cis3, Role: student, Time: 0h 0m 0s

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 1

1. View All Users
2. View by Role
3. View by Class
Enter choice for view: 1
Username: Bob, Role: student, Class: cis3, Time: 0h 0m 0s
Username: alex, Role: instructor
Username: jake, Role: student, Class: cis12, Time: 0h 0m 0s

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 5

Enter username of the user to edit time: bob
User not found.

Admin Menu
1. View Users
2. Add User
3. Delete User
```

```
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 5

Enter username of the user to edit time: Bob
Enter new hours (0-9999): 1323123
Invalid time. Please enter a valid number within the range.
Enter new hours (0-9999): 32
Enter new minutes (0-59): 23
Enter new seconds (0-59): 3
User time updated successfully.

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 1

1. View All Users
2. View by Role
3. View by Class
Enter choice for view: 1
Username: Bob, Role: student, Class: cis3, Time: 32h 23m 3s
Username: alex, Role: instructor
Username: jake, Role: student, Class: cis12, Time: 0h 0m 0s

Admin Menu
1. View Users
2. Add User
3. Delete User
4. Edit User
5. Edit User Time
0. Exit to Main Menu
Enter choice: 0


Main Menu
1. Admin Login
2. User Login
3. Create Account
4. Exit
Enter choice: 2
User Login
Enter username: jake
Enter password: 123

User Menu
1. Start Timer
2. Stop Timer
```

```
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 1
Timer started.

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 3
Logged Time: 0h 0m 2s

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 3
Logged Time: 0h 0m 4s

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 2
Timer stopped. Time logged: 0h 0m 6s

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 3
Logged Time: 0h 0m 6s

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 1
Timer started.

User Menu
1. Start Timer
```

```
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 1
Error: Timer is already running.

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 3
Logged Time: 0h 0m 12s

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 3
Logged Time: 0h 0m 13s

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 2
Timer stopped. Time logged: 0h 0m 7s

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 4
Enter new username (leave empty if unchanged): jake
Enter new password (leave empty if unchanged): jake
User details updated successfully.

User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 3
Logged Time: 0h 0m 13s
```

```
User Menu
1. Start Timer
2. Stop Timer
3. Display Logged Time
4. Edit Details
0. Exit to Main Menu
Enter choice: 0

Main Menu
1. Admin Login
2. User Login
3. Create Account
4. Exit
Enter choice: 4
Exiting program.

RUN SUCCESSFUL (total time: 5m 50s)
```