OS Lab

Mini Project - Course Registration Portal (Academia)

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1. Overview

This project simulates a **Course Registration Portal** using a **client-server architecture** via the terminal. The portal supports **three types of users**: Admin, Faculty, and Student — each with role-specific privileges.

Communication between the client and server is handled using **socket programming**, and data is stored in **files protected by locking mechanisms** to ensure consistency during concurrent access.

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2. Application Architecture

The system comprises the following components:

- `client.c` — Client-side logic for handling different roles (Admin/Faculty/Student).
- `server.c` — Server-side logic that handles all user requests.
- `server_utils.h` — Contains shared macros, constants, and structure definitions.
- `students.dat`, `faculty.dat`, `courses.dat`, `users.dat`, `enrollments.dat` — File-based data stores for persistence.
- `Makefile` — For compiling the system easily.

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3. How to Run the Code

1. Open **two terminals**.
2. In the **first terminal**, compile and run the server:

```
gcc server.c server_utils.c -o server
./server
```

3. In the **second terminal**, compile and run the client:

```
gcc client.c -o client
./client
```

4. Follow the role-based login and navigate the menu-based system.

4. `server_utils.h`

Key structures and constants defined:

- `User` : username, password, role (Admin/Faculty/Student), active status
- `Student` , `Faculty` : profile and academic details
- `Course` : name, assigned faculty, max and available seats, active status
- `Enrollment` : links student ID to course ID

5. Functionalities of Each User

Admin

- Add Student / Faculty
- Activate / Deactivate Student
- Update Student / Faculty Details
- Add / Remove Courses
- Assign Faculty to Courses
- View all Users and Courses
- Change Password

Student

- Enroll in Courses (if seats available)
- Unenroll from Courses
- View Enrolled Courses
- Change Password

Faculty

- Add / Remove Courses
- View Enrollments in Their Courses
- Change Password

6. Functionalities of the Server

The server handles:

- User authentication and session management
- Role-based request routing
- File I/O operations with file locking
- Course seat validation and enrollment
- Support for multiple clients via `pthread_create()`

7. Implementation of `client.c`

Key Functions

- `loginMenu()` — Select role and login
- `adminMenu()`, `facultyMenu()`, `studentMenu()` — Role-specific menu loops
- Uses `read_message()` / `send_message()` for socket communication
  Each menu option gathers inputs and sends requests to the server for execution.

8. Implementation of `server.c`

Key Helper Functions

- `authenticate_user()` — Validates credentials
- `add_student()`, `add_faculty()` — Adds users to database
- `add_course()`, `remove_course()` — Course management
- `enroll_course()`, `unenroll_course()` — Handles student enrollments
- `view_enrollments()` — Lists students per course
- `change_password()` — Password update logic
- Uses `fcntl()` for file locking (read/write based on operation)

9. OS Concepts Used

File Locking

- `fcntl()` is used to implement locking:
  - **Read locks** for viewing (e.g., course list, enrollments)
  - **Write locks** for modifying (e.g., enroll/unenroll, update course)

Socket Programming

- **Server-side**:
  - `socket()`, `bind()`, `listen()`, `accept()`
- **Client-side**:
  - `socket()`, `connect()`
- **Data exchange**:
  - `recieve_message()`, `send_message()` between server and client

File Handling

- Basic system calls used:
  - `open()`, `read()`, `write()`, `close()`
- Files used:
  - `students.dat`, `faculty.dat`, `courses.dat`, `users.dat`, `enrollments.dat`

IPC

- `pthread_create()` system call enables handling multiple clients concurrently by creating a thread for each client

10. Example Screenshots

```
============================================================
            Welcome to Course Registration Portal
============================================================


+-----------------------------+
| Options:-                   |
| 1. Login                    |
| 2. Sign Up                  |
+-----------------------------+
Enter your choice: █
```

```
Enter your choice: 1
Username: admin
Password: admin123
Welcome, admin!


============================================================
                    ADMIN MENU
============================================================


+-------------------------------------------------+
| 1. Add Student                                  |
| 2. Add Faculty                                  |
| 3. Activate/Deactivate Student                  |
| 4. Update Student/Faculty details               |
| 5. Exit                                         |
+-------------------------------------------------+
Enter your choice: █
```

- Creating new Student

```
=========================================================
          Welcome to Course Registration Portal
=========================================================


+--------------------------+
| Options:-                |
| 1. Login                 |
| 2. Sign Up               |
+--------------------------+
Enter your choice: 2


=========================================================
                  CREATE NEW ACCOUNT
=========================================================


Username: Anirudh
Password: hello123
Role (1 for Admin, 2 for Faculty, 3 for Student): 3
Name: Gourav
Department: CSE
Semester: 5
Account created successfully. Please login with your new credentials.
Server disconnected
```

- Faculty Adding course

```
=============================================================
                      FACULTY MENU
=============================================================


+------------------------------------------+
| 1. Add new Course                        |
| 2. Remove offered Course                 |
| 3. View enrollments in Courses           |
| 4. Password Change                       |
| 5. Exit                                  |
+------------------------------------------+
Enter your choice: 1


=============================================================
                      ADD COURSE
=============================================================


Course Name: OS
Maximum Seats: 100
Course added successfully.
```

- Student Enrolling to course

```
========================================================
                   STUDENT MENU
========================================================


+----------------------------------------+
| 1. Enroll to new Courses               |
| 2. Unenroll from already enrolled Courses|
| 3. View enrolled Courses               |
| 4. Password Change                     |
| 5. Exit                                |
+----------------------------------------+
Enter your choice: 1


========================================================
                 AVAILABLE COURSES
========================================================


+-------+-------------------+-------------------+---------------+
| ID    | Name              | Faculty           | Available     |
+-------+-------------------+-------------------+---------------+
| 2     | OS                | Faculty1          | 100           |
+-------+-------------------+-------------------+---------------+


Enter Course ID to enroll (0 to cancel): 2
Enrolled in course successfully.
```

- Viewing all the courses enrolled to

```
| 1. Enroll to new Courses               |
| 2. Unenroll from already enrolled Courses|
| 3. View enrolled Courses               |
| 4. Password Change                     |
| 5. Exit                                |
+----------------------------------------+
Enter your choice: 3


========================================================
                 ENROLLED COURSES
========================================================


+-------+-------------------+--------------------+
| ID    | Name              | Faculty            |
+-------+-------------------+--------------------+
| 2     | OS                | Faculty1           |
+-------+-------------------+--------------------+
```

- Unenrolling from a course

```
================================================================
                        ENROLLED COURSES
================================================================


+-------+-------------------+--------------------+
| ID    | Name              | Faculty            |
+-------+-------------------+--------------------+
| 2     | OS                | Faculty1           |
+-------+-------------------+--------------------+


Enter Course ID to unenroll (0 to cancel): 2
Unenrolled from course successfully.
```

- Viewing enrollments in the faculty role

```
================================================================
                        FACULTY MENU
================================================================


+------------------------------------------------+
| 1. Add new Course                              |
| 2. Remove offered Course                       |
| 3. View enrollments in Courses                 |
| 4. Password Change                             |
| 5. Exit                                        |
+------------------------------------------------+
Enter your choice: 3


================================================================
                        YOUR COURSES
================================================================


+-------+-------------------+-----------+----------------+
| ID    | Name              | Max Seats | Available      |
+-------+-------------------+-----------+----------------+
| 2     | OS                | 100       | 99             |
+-------+-------------------+-----------+----------------+


Enter Course ID to view enrollments (0 to cancel): 2


================================================================
                ENROLLMENTS FOR COURSE: OS
================================================================


+------------+--------------------------------+
| Student ID | Student Name                   |
+------------+--------------------------------+
| 7          | Student1                       |
+------------+--------------------------------+
```

- Admin activating or deactivating a student

```
==============================================================
                        ADMIN MENU
==============================================================


+--------------------------------------------+
| 1. Add Student                             |
| 2. Add Faculty                             |
| 3. Activate/Deactivate Student             |
| 4. Update Student/Faculty details          |
| 5. Exit                                    |
+--------------------------------------------+
Enter your choice: 3


==============================================================
                ACTIVATE/DEACTIVATE STUDENT
==============================================================


Enter student username: student1
Student deactivated successfully.
```

- The deactivated student

```
==============================================================
                Welcome to Course Registration Portal
==============================================================


+---------------------------+
| Options:-                 |
| 1. Login                  |
| 2. Sign Up                |
+---------------------------+
Enter your choice: 1
Username: student1
Password: hello
Your account is inactive. Please contact the administrator.
Server disconnected
```

- Changing password

```
Welcome, faculty1!


=========================================================
                    FACULTY MENU
=========================================================


+----------------------------------------+
| 1. Add new Course                       |
| 2. Remove offered Course                |
| 3. View enrollments in Courses          |
| 4. Password Change                      |
| 5. Exit                                 |
+----------------------------------------+
Enter your choice: 4


=========================================================
                  CHANGE PASSWORD
=========================================================


Enter new password: hello
Password changed successfully.
```

- Removing of course by faculty

```
=========================================================
                    FACULTY MENU
=========================================================


+----------------------------------------+
| 1. Add new Course                       |
| 2. Remove offered Course                |
| 3. View enrollments in Courses          |
| 4. Password Change                      |
| 5. Exit                                 |
+----------------------------------------+
Enter your choice: 2


=========================================================
                   REMOVE COURSE
=========================================================


Enter Course ID: 2
Course removed successfully.
```

- Admin updating student details

```
================================================================
                        ADMIN MENU
================================================================


+-------------------------------------------+
| 1. Add Student                            |
| 2. Add Faculty                            |
| 3. Activate/Deactivate Student            |
| 4. Update Student/Faculty details         |
| 5. Exit                                   |
+-------------------------------------------+
Enter your choice: 4


================================================================
              UPDATE STUDENT/FACULTY DETAILS
================================================================


Enter username: student1
Enter new name (leave empty to keep current): student2
Enter new department (leave empty to keep current): ECE
Enter new semester (leave empty to keep current): 0
Student details updated successfully.
```

- Admin adding student

```
================================================================
                        ADMIN MENU
================================================================


+-------------------------------------------+
| 1. Add Student                            |
| 2. Add Faculty                            |
| 3. Activate/Deactivate Student            |
| 4. Update Student/Faculty details         |
| 5. Exit                                   |
+-------------------------------------------+
Enter your choice: 1


================================================================
                        ADD STUDENT
================================================================

Username: student2
Password: hello
Name: Student2
Department: CSE
Semester: 5
Student added successfully.
```