Thapar institute of engineering and technology

(Deemed to be University)

Patiala, Punjab



**A Mini Project On**

**“University Management System”**

**For the partial complement of Database Management System 2025**

**Under the supervision of**

**“Dr. Shashank Singh”**

**Department of Computer Science and Engineering**

**Submitted By:**

**“Sajid Miya” 102367013**

**Submitted To:**

THAPAR Institute OF ENGINEERING AND TECHNOLOGY

**Department of Computer Science and Engineering Patiala, Punjab, India**

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# 1. INTRODUCTION

## 1.1 Background

Universities and educational institutions handle a vast amount of data and complex processes daily. Traditional manual methods involving paper records or scattered digital files are often inefficient, prone to errors, data redundancy, and difficulties in information retrieval and coordination. An automated, centralized management system is essential for modern institutions to operate smoothly and provide better services to students and faculty.

## 1.2 Problem Statement

Managing student records, course enrollments, faculty details, exam schedules, fee payments, and result processing manually is time-consuming, resource-intensive, and susceptible to errors. Key challenges include:

* Inefficiencies in student registration and course enrollment leading to potential conflicts or delays.
* Difficulties in accurately tracking student academic progress, fee dues, and payment status.
* Lack of a streamlined process for faculty to manage their courses, schedule exams efficiently, evaluate results consistently, and communicate them promptly.
* Significant administrative overhead in handling paperwork, record-keeping, approvals, rejections, and communication across departments.
* Potential data security vulnerabilities and data redundancy issues associated with decentralized or paper-based systems.

This project develops a comprehensive University Management System (UMS) to address these challenges by providing a centralized, automated, role-based, and secure platform.

## 1.3 Objectives

* To develop a centralized database system for efficient management of student, faculty, course, exam, fee, department, and administrative data.
* To automate core university processes, including student registration, course enrollment, exam scheduling, result evaluation and publication, and fee tracking.
* To enhance data security and ensure appropriate access levels through distinct role-based interfaces (Admin, Faculty, Student).
* To minimize manual errors and data redundancy by implementing a well-structured relational database schema with appropriate constraints.
* To provide an intuitive and user-friendly web interface for all user types to interact with the system effectively.
* To create a scalable and maintainable system architecture capable of supporting institutional needs.
* To implement automated email notifications for critical system events such as registration approvals/rejections and credential distribution.

## 1.4 Scope of the Project

### 1.4.1 Functional Scope

* **Student Management:**
* Registration of new students with verification and approval by administrators.
* Managing student profiles, viewing enrollment status, and handling course registrations/unenrollment.
* Displaying personalized dashboards with exam schedules, results, and fee status.
* Simulated fee payment functionality.
* **Faculty Management:**
* Registration of faculty members with verification by administrators.
* Managing faculty profiles, viewing assigned courses, and examination responsibilities.
* Providing personalized dashboards with relevant academic information.
* Managing exams (add, update, delete), evaluating results (mark entry, grading), and locking results.
* **Course Management:**
* Creation, modification, and deletion of courses by administrators.
* Management of course details (ID, name, semester, credits, price).
* **Examination Management:**
* Scheduling exams (including type, date, duration, venue) by faculty for their assigned course.
* Admin overview and management of exams.
* Storing and managing exam results (marks, grades, status).
* **Fee Management:**
* Generating fee records based on registration, course enrollment, and exams.
* Allowing administrators to manage fee records.
* Displaying pending/completed fee transactions on student dashboards.
* Tracking simulated payments via Payment ID.
* **Department Management:**
* Creating, updating, or deleting departments.
* Appointing Heads of Departments (HODs) by administrators from active faculty.
* Associating faculty members with relevant departments.
* **User Authentication and Authorization:**
* Implementing role-based access control (Admin, Faculty, Student).
* Ensuring secure login using official email (`@thapar.edu`) and password, and logout functionalities.
* **Email Notifications:**
* Sending automated emails for registration approval/rejection, credential delivery, and account restrictions.

### 1.4.2. Technical Scope

* Backend Development: Using Flask (Python) as the backend framework.
* Database Management: Implementing MySQL using the PyMySQL connector for handling relational data.
* Frontend Development: Utilizing HTML, CSS, and JavaScript with Jinja2 templating for designing user interfaces.
* Email Handling: Using Flask-Mail for sending automated notifications.
* Database Initialization: Providing scripts (`database\_prerequisite.py`) for database and table creation, and insertion of initial data.

### 1.4.3. Limitations (Out of Scope)

* The system does not include modules for Attendance Tracking, Hostel Management, or Library Management.
* Integration with external learning platforms (e.g., Moodle, Blackboard) is not covered.
* Advanced reporting, analytics, and data visualization features are not implemented.
* Real-time payment gateway integration is excluded; payments are simulated.
* SMS notifications are not implemented.

# 2. SYSTEM DESIGN

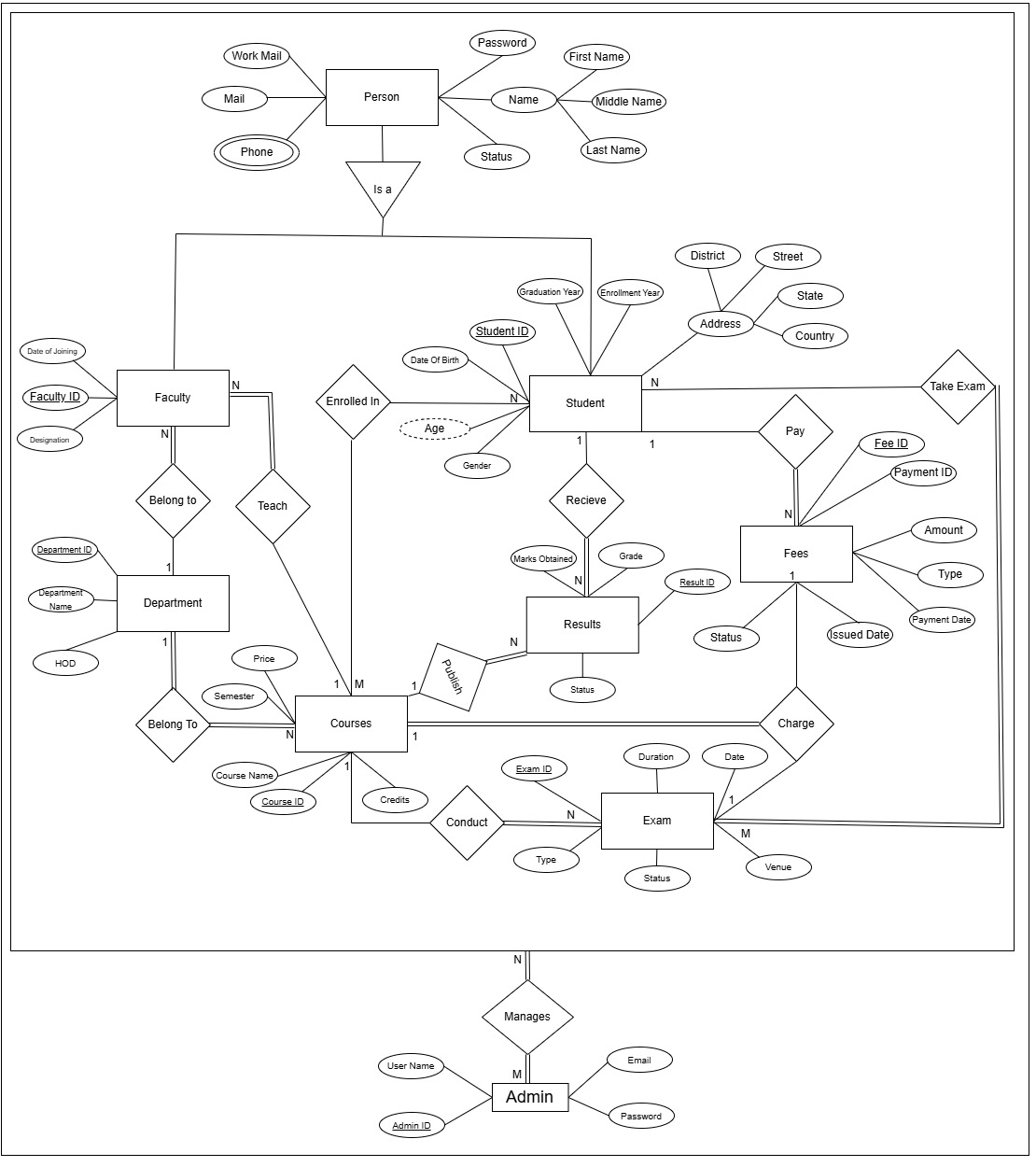
## 2.1 Architecture

The University Management System employs a standard **3-Tier Web Application Architecture**:

* **Presentation Tier (Client-Side)**: Web browsers render HTML pages (from the `templates/` directory) styled with CSS (`static/css/`). Basic JavaScript (`static/scripts/`) handles minor client-side interactions. Jinja2 templating dynamically generates HTML.
* **Application Tier (Server-Side**): The Flask application (`main.py`) processes HTTP requests, manages user sessions, implements business logic (validation, grading), interacts with the database (via PyMySQL), and handles email notifications (via Flask-Mail).
* **Data Tier (Database)**: An externally hosted MySQL database (Aiven cloud) stores persistent data. The schema, defined in `database\_prerequisite.py`, includes tables for students, faculty, courses, etc., with integrity enforced by constraints.

## 2.2 Database Design

### 2.2.1 ER Diagram (Conceptual)



### 2.1.2 ER To Table

The University Management System requires a well-structured database with 12 (including two tables for multivalued attributes of students and faculty) tables to handle various entities and their relationships. The relationships between entities are outlined below:

**1. Students and Courses (N:M Relationship)**

* **Tables Required:** students, courses, enrollment
* Students can enroll in multiple courses, and a course can have multiple students.
* The enrollment table establishes the relationship, with a composite primary key comprising student\_id and course\_id.
* An additional attribute, enrollment\_date, is included.

**2. Faculty and Department (1:N Relationship)**

* **Tables Required:** faculty, department
* A faculty member belongs to a single department, but a department can have multiple faculty members.
* The department table is independent, while the faculty table includes department\_id as a foreign key.

**3. Faculty and Course (1:N Relationship)**

* **Tables Required:** faculty, courses
* A faculty member can teach only one course, but a course can be taught by multiple faculty members.
* The faculty table includes course\_id as a foreign key.

**4. Courses and Exams (1:N Relationship)**

* **Tables Required:** courses, exams
* A course can conduct multiple exams, but each exam is associated with only one course.
* The exam table includes course\_id as a foreign key and exam\_id as the primary key.
* A unique constraint is applied to the combination of course\_id and type.

**5. Courses and Results (1:N Relationship)**

* **Tables Required:** courses, results
* A course can have multiple results published, but each result belongs to only one course.
* The results table includes course\_id as a foreign key.

**6. Students and Exams (N:M Relationship)**

* **Tables Required:** students, exams, takes\_exams
* A student can take multiple exams, and an exam can be given by multiple students enrolled in the same course.
* The takes\_exams table contains a composite primary key of student\_id and exam\_id.

**7. Students and Results (1:N Relationship)**

* **Tables Required:** students, results
* A student can receive multiple results, but each result is associated with only one student.
* The results table includes student\_id as a foreign key.

**8. Students and Fees (1:N Relationship)**

* **Tables Required:** students, fees
* A student can pay multiple fees, but each fee is linked to only one student.
* The fees table includes student\_id as a foreign key.

**9. Courses and Fees (1:1 Relationship)**

* **Tables Required:** courses, fees
* Each course charges only one fee.
* The fees table includes course\_id as a foreign key.

**10. Exams and Fees (1:1 Relationship)**

* **Tables Required:** exams, fees
* Each exam charges only one fee.
* The fees table includes exam\_id as a foreign key.

**11. Admin Management (1:1 Relationship)**

* **Tables Required:** admin
* The admin manages all entities. Since all entities are managed by the admin, no relationships need to be explicitly established.

### 2.2.3 Normalized Table (Table Definitions)

The database schema comprises the following core tables (defined in `database\_prerequisite.py`):

1. Student

Students(Student\_ID, First\_Name, Middle\_Name, Last\_Name, street, district, state, country, Gender, Date\_of\_Birth, mail, College\_Mail,Password, Enrollment\_Year, Graduation\_Year, Status)

2. Student Phone No

PhoneNumbers(Student\_ID, Phone)

3. Courses

Courses(Course\_ID, Course\_Name, Semester, Credits, Price)

4. Enrollment

Enrollment(Student\_ID, Course\_ID, Enrollment\_On)

5. Fees

Fees(Fee\_ID, Student\_ID,Exam\_ID,Course\_ID, Amount, Issued\_Date, Payment\_Date ,Type, Status,payment\_ID)

6. Exams

Exams(Exam\_ID,Course\_ID, Exam\_Date, Exam\_Duration, Exam\_Type, Venue,Status)

7. Takes Exam

Takes\_Exam(Student\_ID, Exam\_ID,Status)

8.. Results

Results(Result\_ID, Exam\_ID,Student\_ID, Course\_ID, Marks\_Obtained,Grade,Status)

9. Department

Department(Department\_ID, Department\_Name, Head\_Of\_Department)

10. Faculty

Faculty(Faculty\_ID, First\_Name, Middle\_Name, Last\_Name, Date\_Of\_Joining, Designation, Mail,Official\_Mail,Password,Status,Course\_ID,Department\_ID)

11. Faculty Phone No

FacultyPhone(Faculty\_ID, Phone)

12. Admin

Admin(Admin\_ID, User\_Name, Password, Email,Password)

### 2.2.4 Relationship Analysis (Participation)

The participation of entities in various relationships within the University Management System is described below:

1. **Students and Courses:**

* **Partial Participation (Both)** A student may not be enrolled in any course, and some courses may have no students enrolled. Therefore, both entities participate partially in the relationship.

1. **Faculty and Department:**

* **Total Participation (Faculty) & Partial Participation (Department):** Every faculty member must belong to a department, but a department can exist without any faculty members. Faculty participation is total, while department participation is partial.

1. **Faculty and Courses:**

* **Total Participation (Faculty) & Partial Participation (Course):** Every faculty member must teach at least one course. However, some courses may not be assigned to any faculty. Therefore, faculty participation is total, while course participation is partial.

1. **Departments and Courses:**

* **Total Participation (Both):** Every department must offer at least one course, and every course must be offered by a department. Thus, both department and course participation are total.

1. **Courses and Exams:**

* **Total Participation (Exam) & Partial Participation (Course):** Every exam must be associated with a course, but a course may not necessarily conduct exams. Therefore, exams participate totally, while courses participate partially.

1. **Students and Exams:**

* **Total Participation (Exam) & Partial Participation (Student):** Every exam is taken by one or more students, but some students may not have participated in any exams. Hence, exams participate totally, while students participate partially.

1. **Courses, Exams, and Fees:**

* **Total Participation (Course & Exam) & Partial Participation (Fee):** Every course and exam have associated fees, but some fees may not be related to any specific course or exam (e.g., registration fees). Therefore, fees participate partially.

1. **Students and Fees:**

* **Total Participation (Fee) & Partial Participation (Student):** Every fee must be associated with a student, but a student may not have paid any fees. Thus, fees participate totally, while students participate partially.

1. **Admin Management:**

* **Total Participation (Both):** Every entity in the system is managed by an admin, and an admin cannot exist without management authority. Therefore, both participate totally.

1. **Students and Results:**

* **Total Participation (Result) & Partial Participation (Student):** Every result is linked to a student, but not all students may have results published. Thus, results participate totally, while students participate partially.

1. **Courses and Results:**

* **Total Participation (Result) & Partial Participation (Course):** Every result is associated with a course, but some courses may not have any results published. Therefore, results participate totally, while courses participate partially.

# 3. PL/SQL

## 3.1 Triggers

### 3.1.1 Code

def create\_audit\_trigger():

    connection = None

    cursor = None

    try:

        connection = get\_connection(db\_name=DATABASE\_NAME)

        if connection is None:

            return

        cursor = connection.cursor()

        print("\nCreating audit table if it doesn't exist...")

        cursor.execute("""

        CREATE TABLE IF NOT EXISTS audit\_log (

            Audit\_ID INT AUTO\_INCREMENT PRIMARY KEY,

            Event\_Type ENUM('INSERT', 'UPDATE', 'DELETE') NOT NULL,

            Table\_Name VARCHAR(255) NOT NULL,

            Event\_Time DATETIME NOT NULL DEFAULT CURRENT\_TIMESTAMP

        );

        """)

        print("Audit table created or already exists.")

        cursor.execute("SHOW TABLES;")

        tables = cursor.fetchall()

        excluded\_tables = ['audit\_log'] # IMPORTANT: Do not trigger on the audit table itself

        for table\_dict in tables:

            table\_name = list(table\_dict.values())[0] # Get the table name

            if table\_name in excluded\_tables:

                print(f"Skipping trigger creation for '{table\_name}' (excluded).")

                continue

            try:

                print(f"Creating AFTER INSERT trigger for table `{table\_name}`...")

                cursor.execute(f"""

                CREATE TRIGGER `{table\_name}\_after\_insert`

                AFTER INSERT ON `{table\_name}`

                FOR EACH ROW

                INSERT INTO audit\_log (Event\_Type, Table\_Name)

                VALUES ('INSERT', '{table\_name}');

                """)

            except pymysql.Error as e:

                 if e.args[0] == 1359:

                     print(f"AFTER INSERT trigger for `{table\_name}` already exists.")

                 else:

                     print(f"Error creating AFTER INSERT trigger for `{table\_name}`: {e}", file=sys.stderr)

            try:

                print(f"Creating AFTER UPDATE trigger for table `{table\_name}`...")

                cursor.execute(f"""

                CREATE TRIGGER `{table\_name}\_after\_update`

                AFTER UPDATE ON `{table\_name}`

                FOR EACH ROW

                INSERT INTO audit\_log (Event\_Type, Table\_Name)

                VALUES ('UPDATE', '{table\_name}');

                """)

            except pymysql.Error as e:

                 if e.args[0] == 1359: # Error code 1359 is "Trigger already exists"

                     print(f"AFTER UPDATE trigger for `{table\_name}` already exists.")

                 else:

                     print(f"Error creating AFTER UPDATE trigger for `{table\_name}`: {e}", file=sys.stderr)

            try:

                print(f"Creating AFTER DELETE trigger for table `{table\_name}`...")

                cursor.execute(f"""

                CREATE TRIGGER `{table\_name}\_after\_delete`

                AFTER DELETE ON `{table\_name}`

                FOR EACH ROW

                INSERT INTO audit\_log (Event\_Type, Table\_Name)

                VALUES ('DELETE', '{table\_name}');

                """)

            except pymysql.Error as e:

                 if e.args[0] == 1359:

                     print(f"AFTER DELETE trigger for `{table\_name}` already exists.")

                 else:

                     print(f"Error creating AFTER DELETE trigger for `{table\_name}`: {e}", file=sys.stderr)

        connection.commit()

        print("\nAudit triggers creation process complete.")

    except pymysql.Error as err:

        print(f"Error during audit trigger setup: {err}", file=sys.stderr)

        if connection:

            connection.rollback()

    finally:

        if cursor:

            cursor.close()

        if connection:

            connection.close()

### 3.1.2 Output

A screen shot of a computer

AI-generated content may be incorrect.

## 3.2 Procedure

### 3.2.1 Code

def create\_procedure():

    connection = None

    cursor = None

    try:

        connection = get\_connection(db\_name=DATABASE\_NAME)

        if connection is None:

            return

        cursor = connection.cursor()

        print("\nCreating stored procedure `insert\_student` if it doesn't exist...")

        cursor.execute("""

        CREATE PROCEDURE insert\_student (

            IN p\_First\_Name VARCHAR(255),

            IN p\_Middle\_Name VARCHAR(255),

            IN p\_Last\_Name VARCHAR(255),

            IN p\_Street VARCHAR(255),

            IN p\_District VARCHAR(255),

            IN p\_State VARCHAR(255),

            IN p\_Country VARCHAR(255),

            IN p\_Gender ENUM('Male', 'Female', 'Others'),

            IN p\_Date\_of\_Birth DATE,

            IN p\_Email VARCHAR(255),

            IN p\_College\_Email VARCHAR(255),

            IN p\_Password VARCHAR(255),

            IN p\_Enrollment\_Year YEAR

        )

        BEGIN

            DECLARE CONTINUE HANDLER FOR SQLEXCEPTION

            BEGIN

                ROLLBACK;

                SELECT 'Error: Unable to insert student. Please check the input data.' AS Error;

            END;

            START TRANSACTION;

            INSERT INTO students (

                First\_Name, Middle\_Name, Last\_Name, Street, District, State,

                Country, Gender, Date\_of\_Birth, Email, College\_Email, Password, Enrollment\_Year

            ) VALUES (

                p\_First\_Name, p\_Middle\_Name, p\_Last\_Name, p\_Street, p\_District, p\_State,

                p\_Country, p\_Gender, p\_Date\_of\_Birth, p\_Email, p\_College\_Email, p\_Password, p\_Enrollment\_Year

            );

            COMMIT;

            SELECT 'Student inserted successfully.' AS Message;

        END;

        """)

        print("Stored procedure `insert\_student` created successfully.")

    except pymysql.Error as err:

        print(f"Error creating stored procedure: {err}", file=sys.stderr)

    finally:

        if cursor:

            cursor.close()

        if connection:

            connection.close()

3.2.2 outputA screenshot of a computer

AI-generated content may be incorrect.

## 3.3 Demonstrate procedure

### 3.3.1 Code

def demonstrate\_procedure(student\_data):

    connection = None

    cursor = None

    try:

        connection = get\_connection(db\_name=DATABASE\_NAME)

        if connection is None:

            return

        cursor = connection.cursor()

        print("\nDemonstrating the use of `insert\_student` stored procedure...")

        cursor.callproc('insert\_student', (

            student\_data['First\_Name'], student\_data.get('Middle\_Name', ''), student\_data['Last\_Name'],

            student\_data['Street'], student\_data['District'], student\_data['State'],

            student\_data['Country'], student\_data['Gender'], student\_data['Date\_of\_Birth'],

            student\_data['Email'], student\_data['College\_Email'], student\_data['Password'],

            student\_data['Enrollment\_Year']

        ))

        result = cursor.fetchall()

        for row in result:

            print(row)

        connection.commit()

        print("Procedure executed successfully.")

    except pymysql.Error as err:

        print(f"Error demonstrating procedure: {err}", file=sys.stderr)

    finally:

        if cursor:

            cursor.close()

        if connection:

            connection.close()

### 3.2.2 Output

A screenshot of a computer

AI-generated content may be incorrect.

## 3.4 Driver Code

if \_\_name\_\_ == "\_\_main\_\_":

    create\_audit\_trigger()

    create\_procedure()

    students = [

    {

        'First\_Name': 'Obito',

        'Middle\_Name': None,

        'Last\_Name': 'Uchiha',

        'Street': 'Hidden Leaf Village',

        'District': 'Konoha',

        'State': 'Land of Fire',

        'Country': 'Japan',

        'Gender': 'Male',

        'Date\_of\_Birth': '1990-02-10',

        'Email': 'obito.uchiha@example.com',

        'College\_Email': 'obito@thapar.edu',

        'Password': 'Mangekyo123',

        'Enrollment\_Year': 2010

    },

    {

        'First\_Name': 'Rin',

        'Middle\_Name': None,

        'Last\_Name': 'Nohara',

        'Street': 'Hidden Leaf Village',

        'District': 'Konoha',

        'State': 'Land of Fire',

        'Country': 'Japan',

        'Gender': 'Female',

        'Date\_of\_Birth': '1992-06-15',

        'Email': 'rin.nohara@example.com',

        'College\_Email': 'rin@thapar.edu',

        'Password': 'HealingJutsu456',

        'Enrollment\_Year': 2011

    },

    {

        'First\_Name': 'Kakashi',

        'Middle\_Name': None,

        'Last\_Name': 'Hatake',

        'Street': 'Hidden Leaf Village',

        'District': 'Konoha',

        'State': 'Land of Fire',

        'Country': 'Japan',

        'Gender': 'Male',

        'Date\_of\_Birth': '1989-09-15',

        'Email': 'kakashi.hatake@example.com',

        'College\_Email': 'kakashi@thapar.edu',

        'Password': 'Sharingan789',

        'Enrollment\_Year': 2009

    },{

        'First\_Name': 'Obito',

        'Middle\_Name': None,

        'Last\_Name': 'Uchiha',

        'Street': 'Hidden Leaf Village',

        'District': 'Konoha',

        'State': 'Land of Fire',

        'Country': 'Japan',

        'Gender': 'Male',

        'Date\_of\_Birth': '1990-02-10',

        'Email': 'obito.uchiha@example.com',

        'College\_Email': 'obito@thapar.edu',

        'Password': 'Mangekyo123',

        'Enrollment\_Year': 2010

    }

    ]

    for student in students:

        print(f"\nInserting student: {student['First\_Name']} {student['Last\_Name']}")

        demonstrate\_procedure(student)

# 4. Queries

These are some queries used in this project :

## 4.1 Drop database

### 4.1.1 code

def drop\_database():

    """Drops the specified database if it exists."""

    connection = None

    cursor = None

    try:

        # Connect without specifying a database initially to run DROP DATABASE

        connection = get\_connection()

        if connection is None:

            return # Connection failed, already printed error

        cursor = connection.cursor()

        # Use backticks around the database name in SQL

        print(f"\nDropping database `{DATABASE\_NAME}` if it exists...")

        cursor.execute(f"DROP DATABASE IF EXISTS `{DATABASE\_NAME}`;")

        connection.commit()

        print(f"Database `{DATABASE\_NAME}` dropped successfully.")

    except pymysql.Error as err:

        print(f"Error dropping database: {err}", file=sys.stderr)

    finally:

        if cursor:

            cursor.close()

        if connection:

            connection.close()

### 4.1.2 Output

A computer screen with white text

AI-generated content may be incorrect.

## 4.2 Create database

### 4.2.1 Code

def create\_database():

    connection = None

    cursor = None

    try:

        connection = get\_connection()

        if connection is None:

            return

        cursor = connection.cursor()

        print(f"\nCreating database `{DATABASE\_NAME}` if it doesn't exist...")

        cursor.execute(f"CREATE DATABASE IF NOT EXISTS `{DATABASE\_NAME}`;")

        print(f"Database `{DATABASE\_NAME}` created or already exists.")

        if cursor: cursor.close()

        if connection: connection.close()

        # Now connect to the specific database to create tables within it

        connection = get\_connection(db\_name=DATABASE\_NAME)

        if connection is None:

             # Connection to specific DB failed, exit setup

            print("Could not connect to the newly created database. Exiting.", file=sys.stderr)

            sys.exit(1)

        cursor = connection.cursor()

        print("Creating admin table if it doesn't exist...")

        cursor.execute("""

        CREATE TABLE IF NOT EXISTS admin (

            Admin\_ID INT PRIMARY KEY AUTO\_INCREMENT,

            User\_Name VARCHAR(255) NOT NULL,

            Email VARCHAR(255) NOT NULL UNIQUE,

            Password VARCHAR(255) NOT NULL

        );

        """)

        print("Admin table created or already exists.")

        cursor.execute("SELECT COUNT(\*) FROM admin WHERE Email = 'admin@thapar.edu'")

        count = cursor.fetchone()['COUNT(\*)']

        if count == 0:

            print("Inserting initial default admin data...")

            cursor.execute("""

            INSERT INTO admin (User\_Name, Email, Password) VALUES

            ('admin', 'admin@thapar.edu', 'admin@tiet');

            """)

            print("Initial default admin data inserted.")

            connection.commit()

        else:

            print("Default admin user 'admin@thapar.edu' already exists, skipping insertion.")

    except pymysql.Error as err:

        print(f"Error creating database or admin table: {err}", file=sys.stderr)

        if connection:

            connection.rollback()

    finally:

        if cursor:

            cursor.close()

        if connection:

            connection.close()

### 4.2.2 Output:

A screenshot of a computer

AI-generated content may be incorrect.

## 4.3 Create tables and add constraints

### 4.3.1 Code

def create\_tables():

    connection = None

    cursor = None

    try:

        connection = get\_connection(db\_name=DATABASE\_NAME)

        if connection is None:

            return

        cursor = connection.cursor()

        print(f"\nCreating tables in database `{DATABASE\_NAME}`...")

        tables\_sql = [

            ("admin", """

                CREATE TABLE IF NOT EXISTS admin (

                    Admin\_ID INT PRIMARY KEY AUTO\_INCREMENT,

                    User\_Name VARCHAR(255) NOT NULL,

                    Email VARCHAR(255) NOT NULL UNIQUE,

                    Password VARCHAR(255) NOT NULL

                );

            """),

            ("students", """

                CREATE TABLE IF NOT EXISTS students (

                    Student\_ID INT AUTO\_INCREMENT PRIMARY KEY,

                    First\_Name VARCHAR(255) NOT NULL,

                    Middle\_Name VARCHAR(255),

                    Last\_Name VARCHAR(255) NOT NULL,

                    Street VARCHAR(255) NOT NULL,

                    District VARCHAR(255) NOT NULL,

                    State VARCHAR(255) NOT NULL DEFAULT 'Nepal',

                    Country VARCHAR(255) NOT NULL,

                    Gender ENUM('Male', 'Female', 'Others') NOT NULL,

                    Date\_of\_Birth DATE NOT NULL,

                    Email VARCHAR(255) UNIQUE NOT NULL CHECK (Email LIKE '%@%'),

                    College\_Email VARCHAR(255) UNIQUE NOT NULL CHECK (College\_Email LIKE '%@thapar.edu'),

                    Password VARCHAR(255) NOT NULL CHECK (LENGTH(Password) >= 8),

                    Enrollment\_Year YEAR NOT NULL,

                    Graduation\_Year YEAR NOT NULL DEFAULT (Enrollment\_Year + 4),

                    Status ENUM('Pending', 'Enrolled', 'Graduated', 'Restricted') NOT NULL DEFAULT 'Pending'

                );

            """),

            ("courses", """

                CREATE TABLE IF NOT EXISTS courses (

                    Course\_ID VARCHAR(13) PRIMARY KEY,

                    Course\_Name VARCHAR(55) NOT NULL UNIQUE,

                    Semester ENUM('1', '2', '3', '4', '5', '6', '7', '8') NOT NULL,

                    Credits FLOAT NOT NULL,

                    Price FLOAT NOT NULL DEFAULT 0

                );

            """),

             ("department", """

                CREATE TABLE IF NOT EXISTS department (

                    Department\_ID VARCHAR(7) PRIMARY KEY,

                    Department\_Name VARCHAR(255) NOT NULL UNIQUE,

                    Head\_of\_Department INT -- This FK will be added later as it references 'faculty'

                );

            """),

            ("faculty", """

                CREATE TABLE IF NOT EXISTS faculty (

                    Faculty\_ID INT PRIMARY KEY AUTO\_INCREMENT,

                    First\_Name VARCHAR(255) NOT NULL,

                    Middle\_Name VARCHAR(255),

                    Last\_Name VARCHAR(255) NOT NULL,

                    Date\_of\_Joining DATETIME NOT NULL DEFAULT CURRENT\_TIMESTAMP,

                    Designation VARCHAR(32) NOT NULL,

                    Mail VARCHAR(255) NOT NULL, # Assuming this is a personal mail

                    Official\_Mail VARCHAR(255) UNIQUE NOT NULL, # This should be unique like student email

                    Password VARCHAR(255) NOT NULL,

                    Course\_ID VARCHAR(13), # Changed to SET NULL

                    Department\_ID VARCHAR(7) NOT NULL,

                    Status ENUM('Pending', 'Active') DEFAULT 'Pending',

                    FOREIGN KEY (Course\_ID) REFERENCES courses(Course\_ID) ON DELETE SET NULL ON UPDATE CASCADE, # Changed to SET NULL

                    FOREIGN KEY (Department\_ID) REFERENCES department(Department\_ID) ON DELETE CASCADE ON UPDATE CASCADE

                );

            """),

            ("student\_phone\_no", """

                CREATE TABLE IF NOT EXISTS student\_phone\_no (

                    Student\_ID INT NOT NULL,

                    Phone VARCHAR(14) NOT NULL,

                    CONSTRAINT PRIMARY KEY (Student\_ID, Phone),

                    CONSTRAINT FK\_Student FOREIGN KEY (Student\_ID) REFERENCES students(Student\_ID) ON DELETE CASCADE ON UPDATE CASCADE

                );

            """),

            ("faculty\_phone\_no", """

                CREATE TABLE IF NOT EXISTS faculty\_phone\_no (

                    Faculty\_ID INT NOT NULL,

                    Phone VARCHAR(14) NOT NULL,

                    CONSTRAINT PRIMARY KEY (Faculty\_ID, Phone),

                    CONSTRAINT FK\_Faculty\_Phone FOREIGN KEY (Faculty\_ID) REFERENCES faculty(Faculty\_ID) ON DELETE CASCADE ON UPDATE CASCADE

                );

            """),

            ("enrollment", """

                CREATE TABLE IF NOT EXISTS enrollment (

                    Student\_ID INT NOT NULL,

                    Course\_ID VARCHAR(13) NOT NULL,

                    Enrolled\_IN DATE DEFAULT (CURRENT\_DATE), -- Added default date

                    FOREIGN KEY (Student\_ID) REFERENCES students(Student\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    FOREIGN KEY (Course\_ID) REFERENCES courses(Course\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    PRIMARY KEY (Student\_ID, Course\_ID)

                );

            """),

            ("exams", """

                CREATE TABLE IF NOT EXISTS exams (

                    Exam\_ID INT PRIMARY KEY AUTO\_INCREMENT,

                    Course\_ID VARCHAR(13),

                    Exam\_Date DATE NOT NULL,

                    Exam\_Duration FLOAT NOT NULL,

                    Exam\_Type ENUM ('Mid Semester Test', 'End Semester Test', 'Quiz-1', 'Quiz-2', 'Lab Evaluation I', 'Lab Evaluation II', 'Others') NOT NULL,

                    Venue VARCHAR(61) NOT NULL,

                    Status ENUM('Unevaluated','Evaluated','Locked') NOT NULL,

                    CONSTRAINT UNIQUE(Course\_ID, Exam\_Type), # Ensure unique exam type per course

                    FOREIGN KEY (Course\_ID) REFERENCES courses(Course\_ID) ON DELETE CASCADE ON UPDATE CASCADE

                );

            """),

             ("fees", """

                CREATE TABLE IF NOT EXISTS fees (

                    Fee\_ID INT PRIMARY KEY AUTO\_INCREMENT,

                    Student\_ID INT,

                    Exam\_ID INT, -- Fee could be exam related

                    Course\_ID VARCHAR(13), -- Fee could be course registration related

                    Amount FLOAT NOT NULL,

                    Issued\_Date DATE NOT NULL DEFAULT (CURRENT\_DATE),

                    Type ENUM('Registration Fees','Course Registration','Exam Fee','Other') NOT NULL, # Added 'Other'

                    Payment\_Date DATE,

                    Status ENUM('Pending','Paid') DEFAULT 'Pending',

                    Payment\_ID VARCHAR(13), -- Might need to be UNIQUE depending on requirements

                    FOREIGN KEY (Student\_ID) REFERENCES students(Student\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    FOREIGN KEY (Exam\_ID) REFERENCES exams(Exam\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    FOREIGN KEY (Course\_ID) REFERENCES courses(Course\_ID) ON DELETE CASCADE ON UPDATE CASCADE

                );

            """),

            ("takes\_exams", """

                CREATE TABLE IF NOT EXISTS takes\_exams (

                    Student\_ID INT NOT NULL,

                    Exam\_ID INT NOT NULL,

                    Status ENUM('Unevaluated','Evaluated','Locked') DEFAULT 'Unevaluated',

                    FOREIGN KEY (Student\_ID) REFERENCES students(Student\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    FOREIGN KEY (Exam\_ID) REFERENCES exams(Exam\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    PRIMARY KEY (Student\_ID, Exam\_ID)

                );

            """),

             ("results", """

                CREATE TABLE IF NOT EXISTS results (

                    Result\_ID INT PRIMARY KEY AUTO\_INCREMENT,

                    Exam\_ID INT NOT NULL,

                    Student\_ID INT NOT NULL,

                    Course\_ID VARCHAR(13) NOT NULL, -- Result is for a specific exam \*in\* a specific course

                    Marks\_Obtained FLOAT,

                    Grade ENUM('A', 'A-', 'B', 'B-', 'C', 'C-', 'D', 'E', 'F'), -- Added F for failing

                    Status ENUM('Unevaluated','Evaluated','Locked') DEFAULT 'Unevaluated',

                    FOREIGN KEY (Exam\_ID) REFERENCES exams(Exam\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    FOREIGN KEY (Student\_ID) REFERENCES students(Student\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    FOREIGN KEY (Course\_ID) REFERENCES courses(Course\_ID) ON DELETE CASCADE ON UPDATE CASCADE,

                    -- Ensure the student is enrolled in the course related to the exam? This is complex and often handled by application logic.

                    -- For now, just ensure unique entry per exam/student/course combo.

                    UNIQUE (Exam\_ID, Student\_ID, Course\_ID)

                );

            """),

            ("audit\_log", """

                CREATE TABLE IF NOT EXISTS audit\_log (

                    Audit\_ID INT AUTO\_INCREMENT PRIMARY KEY,

                    Event\_Type ENUM('INSERT', 'UPDATE', 'DELETE') NOT NULL,

                    Table\_Name VARCHAR(255) NOT NULL,

                    Event\_Time DATETIME NOT NULL DEFAULT CURRENT\_TIMESTAMP

                );

            """)

        ]

        for table\_name, sql in tables\_sql:

            print(f"Creating table '{table\_name}' if it doesn't exist...")

            cursor.execute(sql)

            print(f"Table '{table\_name}' created or already exists.")

        print("Adding FK constraint FK\_Head\_of\_Department to department table...")

        try:

            cursor.execute(f"""

                SELECT COUNT(\*)

                FROM information\_schema.TABLE\_CONSTRAINTS

                WHERE CONSTRAINT\_SCHEMA = '{DATABASE\_NAME}'

                AND TABLE\_NAME = 'department'

                AND CONSTRAINT\_NAME = 'FK\_Head\_of\_Department'

                AND CONSTRAINT\_TYPE = 'FOREIGN KEY';

            """)

            constraint\_exists = cursor.fetchone()['COUNT(\*)'] > 0

            if not constraint\_exists:

                cursor.execute("""

                ALTER TABLE department

                ADD CONSTRAINT FK\_Head\_of\_Department

                FOREIGN KEY (Head\_of\_Department) REFERENCES faculty(Faculty\_ID)

                ON DELETE SET NULL -- Use SET NULL because the HOD might be removed

                ON UPDATE CASCADE;

                """)

                print("FK constraint for department.Head\_of\_Department added.")

            else:

                 print("FK constraint for department.Head\_of\_Department already exists.")

        except pymysql.Error as e:

             print(f"Error adding FK constraint to department table: {e}", file=sys.stderr)

        connection.commit()

        print("\nAll table structures confirmed in the database.")

        print("\nTables currently in the database:")

        cursor.execute("SHOW TABLES;")

        tables = cursor.fetchall()

        if tables:

            for index, table\_dict in enumerate(tables):

                table\_name = list(table\_dict.values())[0]

                print(f"{index+1}. {table\_name}")

        else:

            print("No tables found in the database.")

    except pymysql.Error as err:

        print(f"Error creating tables or constraints: {err}", file=sys.stderr)

        if connection:

            connection.rollback()

    finally:

        if cursor:

            cursor.close()

        if connection:

            connection.close()

### 4.3.2 Output:

A screenshot of a computer program

AI-generated content may be incorrect. A screenshot of a computer

AI-generated content may be incorrect.

# 5. CONCLUSION

The University Management System project successfully delivers a comprehensive web application tailored for managing essential academic and administrative functions at Thapar Institute. By utilizing the Flask framework, a MySQL database, and standard web technologies, the system provides a centralized, efficient, and role-based platform for students, faculty, and administrators. It effectively automates critical processes such as registration, enrollment, exam management, fee tracking, and result processing, thereby reducing manual workload and the potential for errors. The inclusion of features like automated email notifications, dynamic credential generation, and percentile-based grading enhances its utility. The project demonstrates a practical application of database design principles and full-stack web development to address real-world challenges in university administration, providing a solid foundation for future expansion and improvement.

# 6. REFERENCES

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