MySQL COLLEGE DATABASE

Project Report

By

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Mid - Module Assignment

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Part 1: Construct a Case Study

1.1 Background

Founded in 2020, Manolya College provides flexible, distance education for professionals in technical and entrepreneurial fields. Increasing enrolment has rendered its file-based system inefficient due to data duplication and lack of integration. Challenges include error-prone course management, inconsistent grade recording, and limited student access to course information. To resolve these issues, the college requires a centralized database system integrating its primary entities—admins, teachers, students, and courses—into a cohesive, self-describing framework of records (Connolly and Begg, 2014).

1.2 Requirements

The requirements gathering phase identified functional and non-functional specifications critical to the database design (Table 1). Functional requirements focused on supporting essential workflows (Ullah and Lai, 2011), such as data entry, retrieval, and updates. Non-functional requirements emphasized broader organizational priorities, including system requirement and performance, usability, recoverability, and robust data security to ensure compliance and integrity.

Table 1: Requirements Gathering

Functional	Nonfunctional
Roles: • Admins • Students • Teachers	• User friendly interface (Usability) • Support concurrent requests • The response time should be less than 5 secs • Database and backups should be closely synchronised. • Accessing the database should require authentication (User Account/Password) • Access to the database would timeout after an inactivity of 45 mins • The software should be able to run on systems with a minimum memory of 128 MB • Data usage must conform to GDPR standards
Admins action: • Add/Remove course • Assign course to teachers	
Student action: • View/Register (offered) courses	
Teachers action: • View/Grade (course-registered) students	

Part 2: Define the Data Model

2.1 Entity-Relationship

Figure 1 illustrates four entities (*Admins, Courses, Students, and Teachers*) and their junction tables (*Course_Allocation, Course_Registration, and Grading*). Each is defined by specific attributes, and their interrelations are organized around four primary actions: Create, Allocate, Register, and Grade.

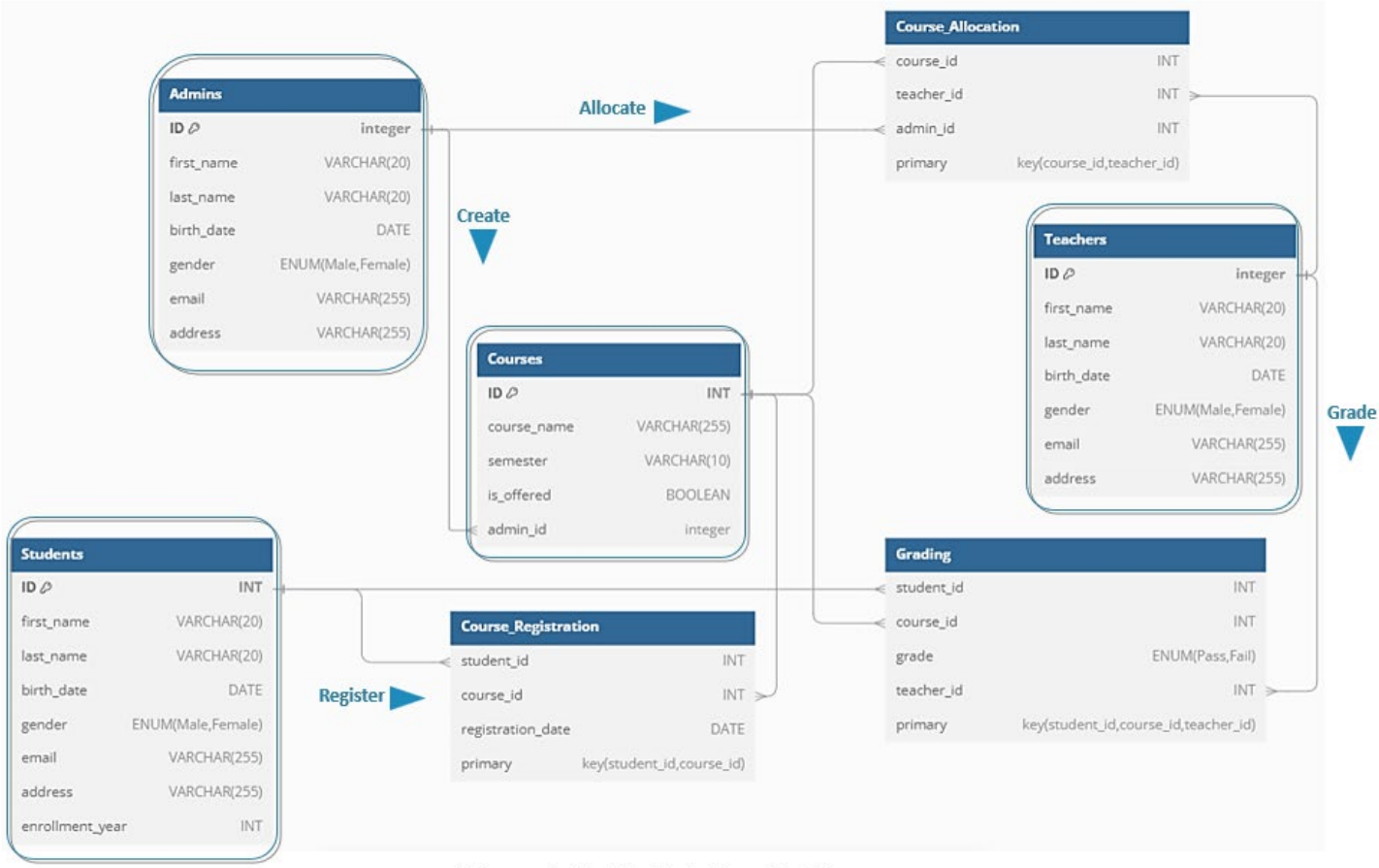


Figure 1: Entity-Relationship Diagram

2.2 Relational Data Model

The relational data model is well-suited for the college's database, offering a structured, predefined schema that supports efficient CRUD operations for managing students, courses, and assessments (Garcia-Molina, Ullman and Widom 2013; Halpin and Morgan, 2020; Watt, 2014). Table 2 outlines the schema, emphasizing relations and attributes while ensuring minimal redundancy, logical dependencies, and data integrity through a three-level normalization process (Codd, 1979; Kumar and Azad, 2017). Constraints, including primary and foreign keys, as well as NOT NULL and UNIQUE checks, enforce data accuracy, as detailed in Table 3.

Table 2: Relational Data Schema

Entity {Attributes} Primary/Composite Key – **Bold**, Foreign Key – *Italicized**	
• Admins {**ID**, first_name, last_name, age, gender, email, address} • Teachers {**ID**, first_name, last_name, age, gender, email, address} • Students { **ID**, first_name, last_name, age, gender, email, address enrollment_year} • Courses {**ID**, course_name, semester, is_offered, *admin_id**} FOREIGN KEY admin_id Admins(ID)	*Entity Relations*
• Course_Allocation {***course_id**, *teacher_id**, *admin_id**} FOREIGN KEY *course_id* Courses(ID) FOREIGN KEY *teacher_id* Teachers(ID) FOREIGN KEY *admin_id* Admins(ID) • Course_Registration {***student_id**, *course_id**, registration_date} FOREIGN KEY *student_id* Students(ID) FOREIGN KEY *course_id* Course(ID) • Grading {***student_id**, *course_id**, grade, ***teacher_id****} FOREIGN KEY *student_id* Students(ID) FOREIGN KEY *course_id* Courses (ID) FOREIGN KEY *graded_by* Teachers(ID)	*Junction Relations*
Normalization • 1NF : Each entity{attributes} is unique and atomic • 2NF : All non-primary key attributes are entirely dependent on their primary key • 3NF : All non-primary key attributes do not share any dependencies among themselves	

Table 3: Select Relation Schema with Data Types and Constraints defined

Relation	Schema + Constraint	Definition
Admins (		
	ID INT (4) PRIMARY KEY,	*unique ID identifying each admin staff*
	first_name VARCHAR(20) NOT NULL,	*text field allowing 20 characters*
	last_name VARCHAR(20) NOT NULL,	*text field allowing 20 characters*
	birth_date DATE	*date of birth YYYY-MM-DD*
	gender ENUM('Male', 'Female') NOT NULL,	*gender, restricted to Male or Female*
	email VARCHAR(255) UNIQUE NOT NULL	*unique email field, required*
	address VARCHAR(255)	*address field allowing up to 255 characters*
);		
Students (		
	ID INT (4) PRIMARY KEY,	*unique ID identifying each student*
	first_name VARCHAR(20) NOT NULL,	*text field allowing 20 characters*
	last_name VARCHAR(20) NOT NULL,	*text field allowing 20 characters*
	birth_date DATE	*date of birth YYYY-MM-DD*
	gender ENUM('Male', 'Female') NOT NULL,	*gender, restricted to Male or Female*
	email VARCHAR(255) UNIQUE NOT NULL	*unique email field, required*
	address VARCHAR(255)	*address field allowing up to 255 characters*
	enrollment_year INT (4)	*year the student was enrolled (4 digits)*
);		
Courses (		
	ID INT (3) PRIMARY KEY,	*unique ID identifying each course*
	course_name VARCHAR(255) ,	*text field allowing 255 characters*
	semester VARCHAR(10),	*text field allowing 10 characters*
	is_offered BOOLEAN,	*boolean indicating if the course is offered*
	admin_id INT (4),	*foreign key referencing admin who created the course*
	FOREIGN KEY (admin_id) REFERENCES Admins(ID)	*foreign key (admin_id) linked to the Admins table (ID)*
);		

Part 3: Implement Database

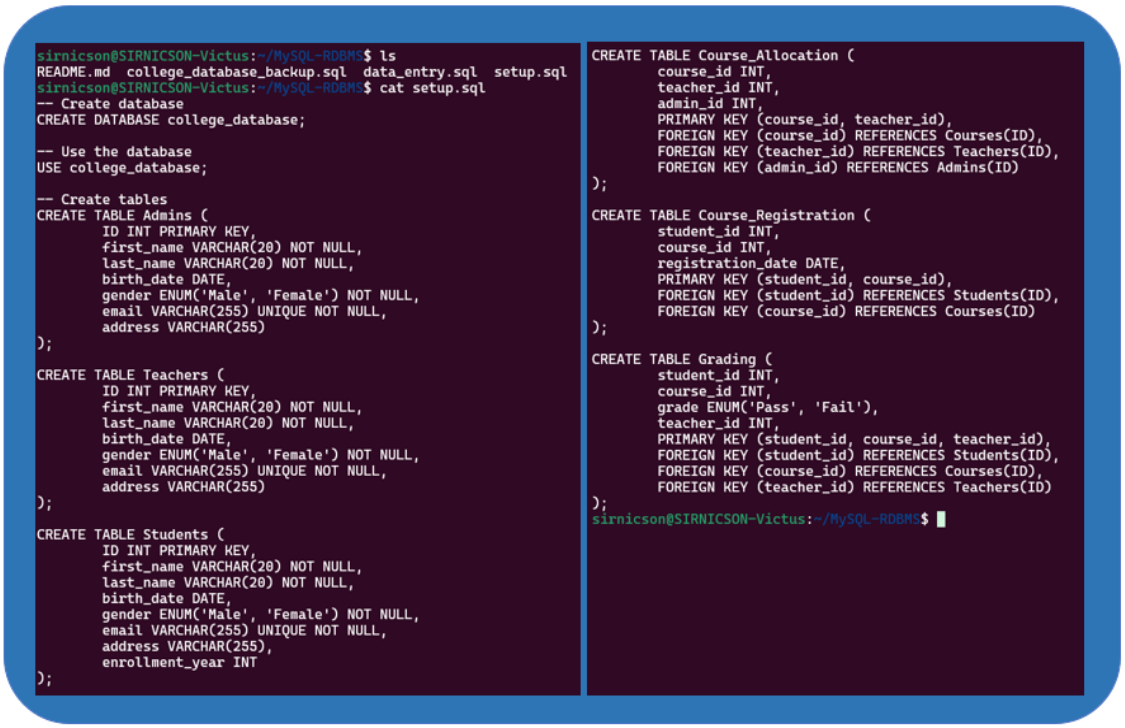
3.1 Development Environment

MySQL, a widely used open-source RDBMS, was chosen for its reliability, scalability, and robust support for relational data integrity (Matthew and Stones, 2007; Grippa and Kuzmichev, 2021; MySQL, 2001). Development utilized version 6.5.1 of the MySQL Command-Line client (mysql) on an Ubuntu 20.04 LTS operating system (Fig. 2). The command-line interface offers advanced input line editing and supports querying, altering, and defining relational databases through declarative statements (Halvorsen, 2016; MySQL Documentation, 2024).

Figure 2: Command-Line Client (mysql) as used on an Ubuntu 20.04.1

3.2 Database Script

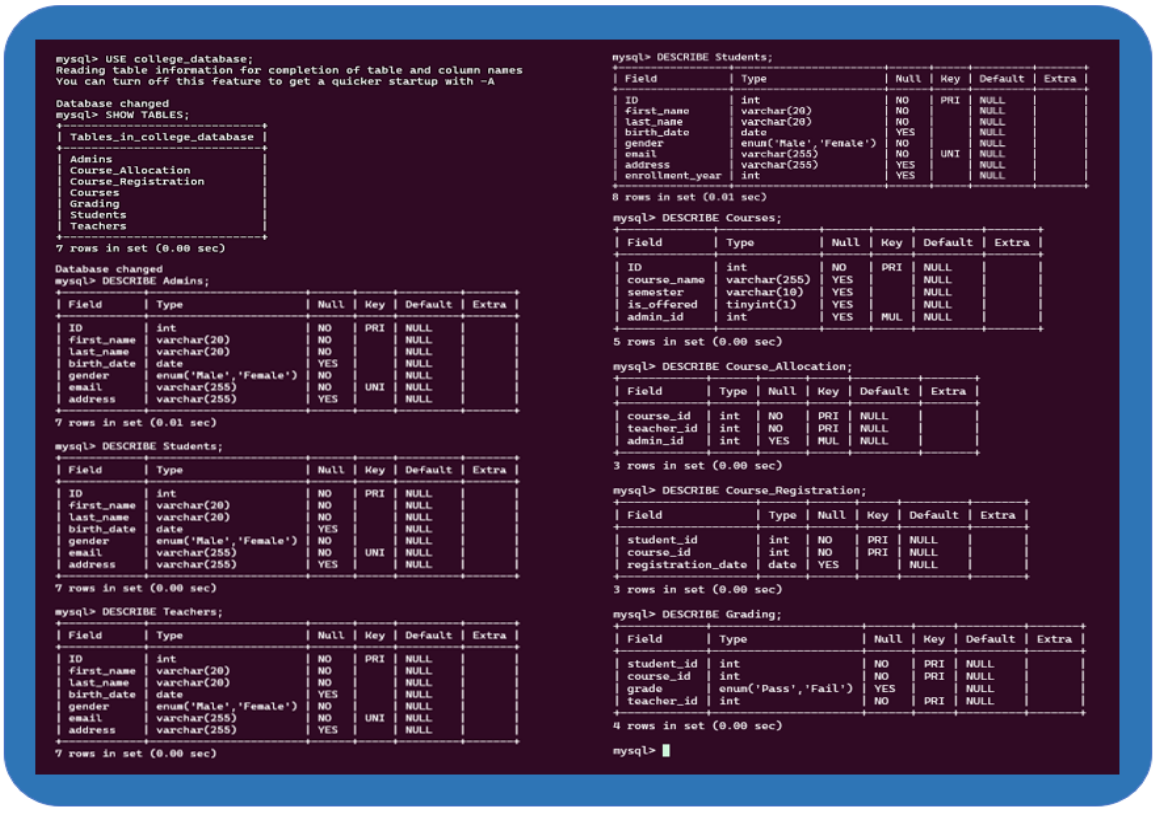
The ***setup.sql*** script (Fig. 3) initialises the database, creating primary tables (Admins, Teachers, Students, Courses) with primary keys and attributes, and junction tables (Course_Allocation, Course_Registration, Grading) for many-to-many relationships.



```
sirnicson@SIRNICSON-Victus:~/MySQL-RDBMS$ ls
README.md  college_database_backup.sql  data_entry.sql  setup.sql
sirnicson@SIRNICSON-Victus:~/MySQL-RDBMS$ cat setup.sql
-- Create database
CREATE DATABASE college_database;

-- Use the database
USE college_database;

-- Create tables
CREATE TABLE Admins (
        ID INT PRIMARY KEY,
        first_name VARCHAR(20) NOT NULL,
        last_name VARCHAR(20) NOT NULL,
        birth_date DATE,
        gender ENUM('Male', 'Female') NOT NULL,
        email VARCHAR(255) UNIQUE NOT NULL,
        address VARCHAR(255)
);

CREATE TABLE Teachers (
        ID INT PRIMARY KEY,
        first_name VARCHAR(20) NOT NULL,
        last_name VARCHAR(20) NOT NULL,
        birth_date DATE,
        gender ENUM('Male', 'Female') NOT NULL,
        email VARCHAR(255) UNIQUE NOT NULL,
        address VARCHAR(255)
);

CREATE TABLE Students (
        ID INT PRIMARY KEY,
        first_name VARCHAR(20) NOT NULL,
        last_name VARCHAR(20) NOT NULL,
        birth_date DATE,
        gender ENUM('Male', 'Female') NOT NULL,
        email VARCHAR(255) UNIQUE NOT NULL,
        address VARCHAR(255),
        enrollment_year INT
);
```

```
CREATE TABLE Course_Allocation (
        course_id INT,
        teacher_id INT,
        admin_id INT,
        PRIMARY KEY (course_id, teacher_id),
        FOREIGN KEY (course_id) REFERENCES Courses(ID),
        FOREIGN KEY (teacher_id) REFERENCES Teachers(ID),
        FOREIGN KEY (admin_id) REFERENCES Admins(ID)
);

CREATE TABLE Course_Registration (
        student_id INT,
        course_id INT,
        registration_date DATE,
        PRIMARY KEY (student_id, course_id),
        FOREIGN KEY (student_id) REFERENCES Students(ID),
        FOREIGN KEY (course_id) REFERENCES Courses(ID)
);

CREATE TABLE Grading (
        student_id INT,
        course_id INT,
        grade ENUM('Pass', 'Fail'),
        teacher_id INT,
        PRIMARY KEY (student_id, course_id, teacher_id),
        FOREIGN KEY (student_id) REFERENCES Students(ID),
        FOREIGN KEY (course_id) REFERENCES Courses(ID),
        FOREIGN KEY (teacher_id) REFERENCES Teachers(ID)
);
sirnicson@SIRNICSON-Victus:~/MySQL-RDBMS$
```

Figure 3: Database setup script



```
mysql> USE college_database;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> SHOW TABLES;
+-----------------------------+
| Tables_in_college_database |
+-----------------------------+
| Admins                      |
| Course_Allocation           |
| Course_Registration         |
| Courses                     |
| Grading                     |
| Students                    |
| Teachers                    |
+-----------------------------+
7 rows in set (0.00 sec)

Database changed
mysql> DESCRIBE Admins;
+------------+-----------------------+------+-----+---------+-------+
| Field      | Type                  | Null | Key | Default | Extra |
+------------+-----------------------+------+-----+---------+-------+
| ID         | int                   | NO   | PRI | NULL    |       |
| first_name | varchar(20)           | NO   |     | NULL    |       |
| last_name  | varchar(20)           | NO   |     | NULL    |       |
| birth_date | date                  | YES  |     | NULL    |       |
| gender     | enum('Male','Female') | NO   |     | NULL    |       |
| email      | varchar(255)          | NO   | UNI | NULL    |       |
| address    | varchar(255)          | YES  |     | NULL    |       |
+------------+-----------------------+------+-----+---------+-------+
7 rows in set (0.01 sec)

mysql> DESCRIBE Students;
+------------+-----------------------+------+-----+---------+-------+
| Field      | Type                  | Null | Key | Default | Extra |
+------------+-----------------------+------+-----+---------+-------+
| ID         | int                   | NO   | PRI | NULL    |       |
| first_name | varchar(20)           | NO   |     | NULL    |       |
| last_name  | varchar(20)           | NO   |     | NULL    |       |
| birth_date | date                  | YES  |     | NULL    |       |
| gender     | enum('Male','Female') | NO   |     | NULL    |       |
| email      | varchar(255)          | NO   | UNI | NULL    |       |
| address    | varchar(255)          | YES  |     | NULL    |       |
+------------+-----------------------+------+-----+---------+-------+
7 rows in set (0.00 sec)

mysql> DESCRIBE Teachers;
+------------+-----------------------+------+-----+---------+-------+
| Field      | Type                  | Null | Key | Default | Extra |
+------------+-----------------------+------+-----+---------+-------+
| ID         | int                   | NO   | PRI | NULL    |       |
| first_name | varchar(20)           | NO   |     | NULL    |       |
| last_name  | varchar(20)           | NO   |     | NULL    |       |
| birth_date | date                  | YES  |     | NULL    |       |
| gender     | enum('Male','Female') | NO   |     | NULL    |       |
| email      | varchar(255)          | NO   | UNI | NULL    |       |
| address    | varchar(255)          | YES  |     | NULL    |       |
+------------+-----------------------+------+-----+---------+-------+
7 rows in set (0.00 sec)
```

```
mysql> DESCRIBE Students;
+---------------+-----------------------+------+-----+---------+-------+
| Field         | Type                  | Null | Key | Default | Extra |
+---------------+-----------------------+------+-----+---------+-------+
| ID            | int                   | NO   | PRI | NULL    |       |
| first_name    | varchar(20)           | NO   |     | NULL    |       |
| last_name     | varchar(20)           | NO   |     | NULL    |       |
| birth_date    | date                  | YES  |     | NULL    |       |
| gender        | enum('Male','Female') | NO   |     | NULL    |       |
| email         | varchar(255)          | NO   | UNI | NULL    |       |
| address       | varchar(255)          | YES  |     | NULL    |       |
| enrollment_year | int                 | YES  |     | NULL    |       |
+---------------+-----------------------+------+-----+---------+-------+
8 rows in set (0.01 sec)

mysql> DESCRIBE Courses;
+-------------+--------------+------+-----+---------+-------+
| Field       | Type         | Null | Key | Default | Extra |
+-------------+--------------+------+-----+---------+-------+
| ID          | int          | NO   | PRI | NULL    |       |
| course_name | varchar(255) | YES  |     | NULL    |       |
| semester    | varchar(10)  | YES  |     | NULL    |       |
| is_offered  | tinyint(1)   | YES  |     | NULL    |       |
| admin_id    | int          | YES  | MUL | NULL    |       |
+-------------+--------------+------+-----+---------+-------+
5 rows in set (0.00 sec)

mysql> DESCRIBE Course_Allocation;
+------------+------+------+-----+---------+-------+
| Field      | Type | Null | Key | Default | Extra |
+------------+------+------+-----+---------+-------+
| course_id  | int  | NO   | PRI | NULL    |       |
| teacher_id | int  | NO   | PRI | NULL    |       |
| admin_id   | int  | YES  | MUL | NULL    |       |
+------------+------+------+-----+---------+-------+
3 rows in set (0.00 sec)

mysql> DESCRIBE Course_Registration;
+-----------------+------+------+-----+---------+-------+
| Field           | Type | Null | Key | Default | Extra |
+-----------------+------+------+-----+---------+-------+
| student_id      | int  | NO   | PRI | NULL    |       |
| course_id       | int  | NO   | PRI | NULL    |       |
| registration_date | date | YES |     | NULL    |       |
+-----------------+------+------+-----+---------+-------+
3 rows in set (0.00 sec)

mysql> DESCRIBE Grading;
+------------+-----------------------+------+-----+---------+-------+
| Field      | Type                  | Null | Key | Default | Extra |
+------------+-----------------------+------+-----+---------+-------+
| student_id | int                   | NO   | PRI | NULL    |       |
| course_id  | int                   | NO   | PRI | NULL    |       |
| grade      | enum('Pass','Fail')   | YES  |     | NULL    |       |
| teacher_id | int                   | NO   | PRI | NULL    |       |
+------------+-----------------------+------+-----+---------+-------+
4 rows in set (0.00 sec)

mysql>
```

Figure 4: Result of Tables created

Figure 4 shows the tables created after running the script. A batch data entry approach (Microsoft, 2023) was then used to populate the database (Fig. 5) using the ***data_entry.sql*** script (See Appendix).

```
mysql> USE college_database;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> Select * FROM Admins;
+------+------------+-----------+------------+--------+---------------------+---------------------------------------+
| ID   | first_name | last_name | birth_date | gender | email               | address                               |
+------+------------+-----------+------------+--------+---------------------+---------------------------------------+
| 1014 | Olawole    | Ayoba     | 1985-05-15 | Male   | oayoba@manolya.edu  | 150 Baker Street, Victoria Island, Lagos |
| 1023 | Nicholas   | Eghagha   | 1990-10-10 | Male   | neghagha@manolya.edu | 300, Chester Avenue, Ikeja, Lagos     |
+------+------------+-----------+------------+--------+---------------------+---------------------------------------+
2 rows in set (0.00 sec)

mysql> Select * FROM Courses;
+-----+---------------------------------------+----------+-------------+----------+
| ID  | course_name                           | semester | is_offered  | admin_id |
+-----+---------------------------------------+----------+-------------+----------+
| 101 | Introduction to Data Science          | Fall     |           1 |     1023 |
| 102 | Web Development Fundamentals          | Fall     |           1 |     1014 |
| 103 | Entrepreneurship in the Digital Age   | Fall     |           1 |     1014 |
| 104 | Database Management Systems           | Fall     |           1 |     1023 |
| 105 | Project Management for Tech Projects  | Fall     |           1 |     1014 |
| 111 | Cybersecurity for Professionals       | Spring   |           1 |     1014 |
| 112 | Machine Learning and AI for Business  | Spring   |           1 |     1023 |
| 113 | Blockchain Technology and Its Applications | Spring |           1 |     1023 |
| 114 | Digital Marketing Strategies          | Spring   |           1 |     1014 |
| 115 | Data Analytics for Business Decisions | Spring   |           1 |     1023 |
+-----+---------------------------------------+----------+-------------+----------+
10 rows in set (0.01 sec)

mysql> Select * FROM Teachers;
+------+------------+-----------+------------+--------+---------------------+-----------------------------------------+
| ID   | first_name | last_name | birth_date | gender | email               | address                                 |
+------+------------+-----------+------------+--------+---------------------+-----------------------------------------+
| 1101 | Sam        | Gudenberg | 1978-04-30 | Male   | sgudenberg@manolya.edu | 10 Karl-Liebknecht-Strasse, Berlin, Germany |
| 1102 | Tom        | Lanester  | 1975-03-22 | Male   | tlanester@manolya.edu | 21 Maple Street, Toronto, Canada        |
| 1103 | Matthew    | Eromosele | 1990-07-05 | Male   | meromosele@manolya.edu | 18 Ikoyi Crescent, Lagos, Nigeria       |
| 1154 | Paula      | Manuella  | 1985-11-23 | Female | pmanuella@manolya.edu | 67 Rue de Rivoli, Paris, France         |
| 1167 | Paul       | Harrison  | 1980-06-17 | Male   | pharrison@manolya.edu | 33 5th Avenue, New York, USA            |
| 1216 | Elena      | Augelera  | 1987-09-09 | Female | eagulera@manolya.edu | 45 Las Ramblas, Barcelona, Spain        |
| 1221 | Jane       | Coldwell  | 1982-08-14 | Female | jcoldwell@manolya.edu | 42 Baker Street, London, United Kingdom |
+------+------------+-----------+------------+--------+---------------------+-----------------------------------------+
7 rows in set (0.00 sec)

mysql> Select * FROM Course_Registration;
+------------+-----------+-------------------+
| student_id | course_id | registration_date |
+------------+-----------+-------------------+
|       2204 |       104 | 2023-10-17        |
|       2204 |       105 | 2023-10-18        |
|       2204 |       111 | 2024-03-22        |
|       2204 |       113 | 2024-03-23        |
|       2211 |       102 | 2023-09-12        |
|       2211 |       103 | 2023-09-13        |
|       2211 |       111 | 2024-02-12        |
|       2211 |       113 | 2024-02-16        |
|       2212 |       104 | 2023-09-28        |
|       2212 |       105 | 2023-09-29        |
|       2212 |       111 | 2024-03-04        |
|       2212 |       113 | 2024-03-03        |
|       2217 |       101 | 2023-09-19        |
|       2217 |       102 | 2023-09-18        |
|       2217 |       114 | 2024-02-22        |
|       2217 |       115 | 2024-02-23        |
|       2218 |       101 | 2023-10-10        |
|       2218 |       102 | 2023-10-11        |
|       2218 |       113 | 2024-03-15        |
|       2218 |       115 | 2024-03-16        |
|       2222 |       101 | 2023-10-17        |
|       2222 |       104 | 2023-10-18        |
|       2222 |       114 | 2024-03-22        |
|       2222 |       115 | 2024-03-23        |
|       2228 |       101 | 2023-10-17        |
|       2228 |       105 | 2023-10-18        |
|       2228 |       113 | 2024-03-22        |
|       2228 |       115 | 2024-03-23        |
|       2234 |       102 | 2023-10-17        |
|       2234 |       104 | 2023-10-18        |
|       2415 |       112 | 2024-03-09        |
|       2415 |       113 | 2024-03-10        |
|       2416 |       104 | 2023-10-17        |
|       2416 |       105 | 2023-10-18        |
|       2416 |       114 | 2024-03-22        |
|       2416 |       115 | 2024-03-22        |
|       2418 |       102 | 2023-10-17        |
|       2418 |       103 | 2023-10-18        |
|       2418 |       111 | 2024-03-22        |
|       2418 |       115 | 2024-03-24        |
+------------+-----------+-------------------+
160 rows in set (0.00 sec)

mysql> Select * FROM Grading;
+------------+-----------+-------+------------+
| student_id | course_id | grade | teacher_id |
+------------+-----------+-------+------------+
|       2204 |       104 | Pass  |       1154 |
|       2204 |       105 | Pass  |       1101 |
|       2204 |       111 | Pass  |       1216 |
|       2204 |       113 | Pass  |       1102 |
|       2211 |       102 | Pass  |       1167 |
|       2211 |       103 | Fail  |       1103 |
|       2211 |       111 | Pass  |       1216 |
|       2211 |       113 | Pass  |       1102 |
|       2212 |       104 | Pass  |       1154 |
|       2212 |       105 | Pass  |       1101 |
|       2212 |       111 | Fail  |       1216 |
|       2212 |       113 | Pass  |       1102 |
|       2217 |       101 | Pass  |       1102 |
|       2217 |       102 | Fail  |       1221 |
|       2217 |       114 | Pass  |       1221 |
|       2217 |       115 | Pass  |       1154 |
|       2218 |       101 | Pass  |       1102 |
|       2218 |       102 | Pass  |       1221 |
|       2218 |       113 | Pass  |       1102 |
|       2218 |       115 | Pass  |       1154 |
|       2222 |       101 | Pass  |       1102 |
|       2222 |       104 | Pass  |       1154 |
|       2222 |       114 | Pass  |       1221 |
|       2222 |       115 | Pass  |       1154 |
|       2228 |       101 | Pass  |       1102 |
|       2228 |       105 | Pass  |       1101 |
|       2228 |       113 | Pass  |       1102 |
|       2228 |       115 | Pass  |       1154 |
|       2234 |       102 | Pass  |       1221 |
|       2234 |       104 | Fail  |       1154 |
|       2415 |       112 | Pass  |       1167 |
|       2415 |       113 | Fail  |       1102 |
|       2416 |       104 | Fail  |       1154 |
|       2416 |       105 | Pass  |       1101 |
|       2416 |       114 | Pass  |       1221 |
|       2416 |       115 | Pass  |       1154 |
|       2418 |       102 | Pass  |       1221 |
|       2418 |       103 | Pass  |       1103 |
|       2418 |       111 | Pass  |       1216 |
|       2418 |       115 | Pass  |       1154 |
+------------+-----------+-------+------------+
160 rows in set (0.00 sec)

mysql> Select * FROM Course_Allocation;
+-----------+------------+----------+
| course_id | teacher_id | admin_id |
+-----------+------------+----------+
|       102 |       1221 |     1014 |
|       104 |       1154 |     1014 |
|       111 |       1216 |     1014 |
|       113 |       1102 |     1014 |
|       115 |       1154 |     1014 |
|       101 |       1102 |     1023 |
|       103 |       1103 |     1023 |
|       105 |       1101 |     1023 |
|       112 |       1167 |     1023 |
|       114 |       1221 |     1023 |
+-----------+------------+----------+
10 rows in set (0.00 sec)

mysql> Select * FROM Students;
+------+------------+-----------+------------+--------+---------------------+-----------------------------------------+-----------------+
| ID   | first_name | last_name | birth_date | gender | email               | address                                 | enrollment_year |
+------+------------+-----------+------------+--------+---------------------+-----------------------------------------+-----------------+
| 2204 | Amelia     | Scott     | 1994-02-14 | Female | ascott@manolya.edu  | 20 Marine Drive, Mumbai, India          |            2022 |
| 2211 | Alex       | Brown     | 1993-03-12 | Male   | abrown@manolya.edu  | 120 5th Avenue, New York, USA           |            2022 |
| 2212 | Azra       | Karayilan | 1990-10-30 | Female | akarayilan@manolya.edu | 45 Taksim Square, Istanbul, Turkey      |            2022 |
| 2217 | Shao       | Xie       | 1997-09-01 | Male   | sxie@manolya.edu    | 88 Chang'an Avenue, Beijing, China      |            2022 |
| 2218 | Isabella   | Zaragozze | 1986-04-10 | Female | izaragozze@manolya.edu | 42 Roma Street, Rome, Italy             |            2022 |
| 2222 | Sara       | Imani     | 1990-05-08 | Female | simani@manolya.edu  | 7 Churchill Road, Cape Town, South Africa |            2022 |
| 2228 | Alice      | Gomez     | 1990-09-05 | Female | agomez@manolya.edu  | 90 Rua da Liberdade, Lisbon, Portugal   |            2022 |
| 2234 | Grace      | Kim       | 1990-11-09 | Female | gkim@manolya.edu    | 123 Insadong St, Seoul, South Korea     |            2022 |
| 2304 | Emma       | Agundele  | 1998-05-04 | Female | eagundele@manolya.edu | 32 Victoria Island, Lagos, Nigeria      |            2023 |
| 2306 | Murat      | Çelik     | 1993-09-12 | Male   | mcelik@manolya.edu  | 20 Ataturk Boulevard, Ankara, Turkey    |            2023 |
| 2309 | Lucas      | Brown     | 1993-01-28 | Male   | lucas.brown@manolya.edu | 17 Collins Street, Melbourne, Australia |            2023 |
| 2311 | Chukwudu   | Francis   | 1986-08-15 | Male   | cfrancis@manolya.edu | 15 Marina Street, Lagos, Nigeria        |            2022 |
| 2414 | Leo        | Martinez  | 1987-12-19 | Male   | lmartinez@manolya.edu | 34 Paseo de la Reforma, Mexico City, Mexico |            2024 |
| 2415 | Henry      | Ogbayagbon | 1989-03-03 | Male   | hogbayagbon@manolya.edu | 10 Broad Street, Lagos, Nigeria         |            2024 |
| 2416 | Ava        | Murphy    | 1994-08-24 | Female | amurphy@manolya.edu | 77 Collins St, Melbourne, Australia     |            2024 |
| 2418 | Jaxon      | Lee       | 1991-05-11 | Male   | jlee@manolya.edu    | 55 Shibuya, Tokyo, Japan                |            2024 |
+------+------------+-----------+------------+--------+---------------------+-----------------------------------------+-----------------+
40 rows in set (0.00 sec)
```

Figure 5: Populated Database

3.4 Query Database

Querying the database involved retrieving specific data using declarative statements like SELECT, JOIN, and WHERE to filter and combine information from multiple tables, based on criteria such as course enrolment and academic performance (Fig. 6).

Query 1: The Admissions Office wants a list of the students who are enrolled in the course

```
mysql> SELECT first_name, last_name, gender, email
    -> FROM Students
    -> WHERE ID IN (SELECT student_id FROM
Course_Registration WHERE course_id = 104);
```

first_name	last_name	gender	email
Amelia	Scott	Female	ascott@manolya.edu
Azra	Karayilan	Female	akarayilan@manolya.edu
Sara	Imani	Female	simani@manolya.edu
Grace	Kim	Female	gkim@manolya.edu
Lucas	Brown	Male	lucas.brown@manolya.edu
Marcus	Germaine	Male	mgermaine@manolya.edu
Ethan	Parker	Male	eparker@manolya.edu
Mathias	Jogurnese	Male	mjorgurnese@manolya.edu
Olivia	Pope	Female	opope@manolya.edu
Charlotte	Lime	Female	clime@manolya.edu
George	Carter	Male	gcarter@manolya.edu
Jane	Smith	Female	jsmith@manolya.edu
Zara	Khan	Female	zkhan@manolya.edu
James	Borabora	Male	jborabora@manolya.edu
Liam	Green	Male	lgreen@manolya.edu
Daniel	Victor	Male	dvictor@manolya.edu
Sophia	Alonso	Female	salonso@manolya.edu
Henry	Ogbayagbon	Male	hogbayagbon@manolya.edu
Ava	Murphy	Female	amurphy@manolya.edu

19 rows in set (0.01 sec)

Query 2: The College Provost needs a list of students with their grades for the course 'Project Management for Tech Projects 105'

```
mysql> SELECT S.first_name, S.last_name, G.grade
    -> FROM Students S
    -> JOIN Course_Registration CR ON S.ID = CR.student_id
    -> JOIN Grading G ON CR.course_id = G.course_id
    -> AND CR.student_id = G.student_id
    -> WHERE CR.course_id = 105;
```

first_name	last_name	grade
Amelia	Scott	Pass
Azra	Karayilan	Pass
Alice	Gomez	Pass
Emma	Agundele	Pass
Murat	Çelik	Pass
Mathias	Jogurnese	Pass
Benjamin	Won Su	Pass
Felix	Johnson	Pass
Marta	Silva	Pass
Ella	Roberts	Fail
Oscar	Chen	Pass
Zara	Khan	Fail
Liam	Green	Pass
Daniel	Victor	Pass
Ibrahim	Ali	Pass
Rebecca	Shaw	Pass
Noah	Diaz	Pass
Leo	Martinez	Pass
Ava	Murphy	Pass

19 rows in set (0.00 sec)

Query 3: A student wants to view all the courses on offer for the spring semester.

```
mysql> SELECT course_name
    -> FROM Courses
    -> WHERE semester = 'Spring' AND is_offered = 1;
+-----------------------------------------+
| course_name                             |
+-----------------------------------------+
| Cybersecurity for Professionals         |
| Machine Learning and AI for Business    |
| Blockchain Technology and Its Applications |
| Digital Marketing Strategies            |
| Data Analytics for Business Decisions   |
+-----------------------------------------+
5 rows in set (0.00 sec)
```

Figure 6: Sample Queries testing the database

3.5 Backup

The mysqldump utility was employed to create a logical backup (Fig. 7). Logical backups provide flexibility in modifying table structures or data prior to restoration. However, they may result in slower restore times compared to physical backups, especially for large datasets (MySQL Documentation, 2024).

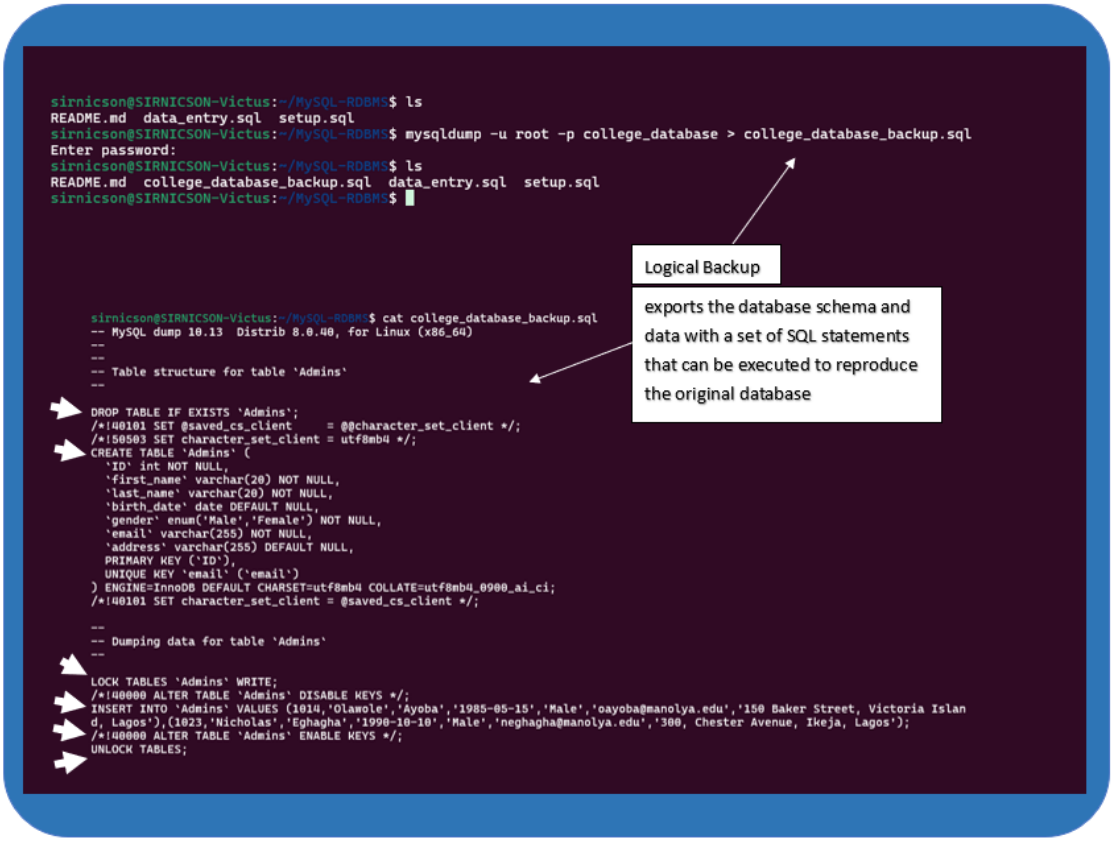


Figure 7: Snippet of Backup file

3.6 Limitations

The database was developed using the MySQL command-line client, which lacks the advanced features and graphical interface of MySQL Workbench.

The reliance on separate tables for admins, teachers, and students, rather than employing role-based access control, introduces potential redundancy and inefficiencies in data management.

Kuhn, Coyne and Weil (2010)

Scalability is constrained, making the database less suited for handling large datasets or high transaction volumes.

Performance may degrade with complex queries unless indexing and optimization techniques are implemented.

Konstantinidis and Ambite (2014)

Figure 8: Limitations

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Appendix: Git Repository

GitHub Repository: sirnicson. (2024). *MySQL-RDBMS*. Available at: https://github.com/sirnicson/MySQL-RDBMS.git [Accessed 15 Nov. 2024].