Week 1: Student Management System Database Project

Team Documentation

Team Members

1. Mohammed Ragab - Database Architect
2. Youssef Mohammed - SQL Developer
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5. Ahmed Harmas - Database Architect
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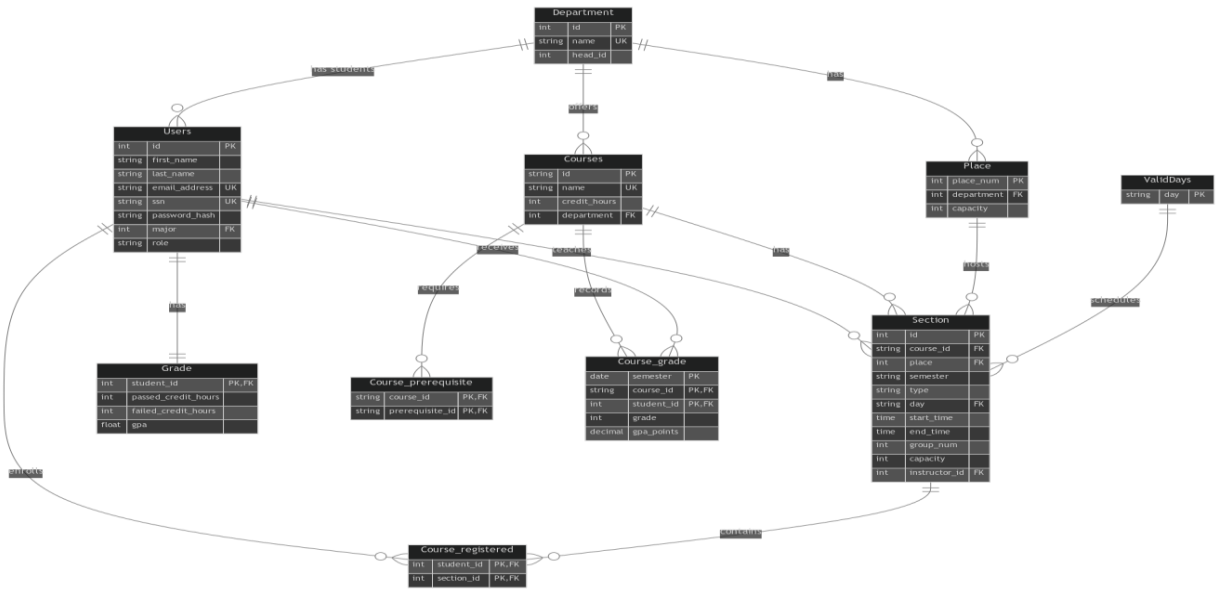
1. Database Design

1.1 Overview

Our team designed a comprehensive Student Management System database to handle various aspects of academic administration. The schema includes functionality for:

- Student and faculty management
- Course registration and prerequisites
- Grade tracking and GPA calculation
- Department and classroom organization
- Course scheduling

1.2 Entity-Relationship Diagram



1.3 Table Structure

The database consists of 10 primary tables:

1. **Department** - Stores academic departments
2. **Users** - Manages all system users (students, tutors, admins)
3. **Grade** - Tracks student GPAs and credit hours
4. **Courses** - Contains course information
5. **Course_prerequisite** - Manages course prerequisites
6. **Place** - Handles classroom information
7. **ValidDays** - Contains valid days for scheduling
8. **Section** - Manages course sections and scheduling
9. **Course_registered** - Tracks student course registration
10. **Course_grade** - Records individual course grades

2. Implementation

2.1 Database Creation

```
CREATE DATABASE StudentManagementSystem;

USE StudentManagementSystem;
```

2.2 Key Table Implementations

Users Table

```
CREATE TABLE Users (
  id INTEGER PRIMARY KEY,
  first_name VARCHAR(20) NOT NULL,
  last_name VARCHAR(20) NOT NULL,
  email_address VARCHAR(50) NOT NULL UNIQUE,
  ssn VARCHAR(20) NOT NULL UNIQUE,
  password_hash VARCHAR(60) NOT NULL,
  major INTEGER,
  role VARCHAR(10) NOT NULL DEFAULT 'Unassigned',
  FOREIGN KEY (major) REFERENCES Department(id),
  CHECK (role IN ('Student', 'Tutor', 'Admin', 'Unassigned'))
```

);

Grade Table

```
CREATE TABLE Grade (
  student_id INTEGER PRIMARY KEY,
  passed_credit_hours INTEGER NOT NULL DEFAULT 0,
  failed_credit_hours INTEGER DEFAULT 0,
  gpa FLOAT NOT NULL DEFAULT 0.0 CHECK (gpa >= 0 AND gpa <= 5.0),
  FOREIGN KEY (student_id) REFERENCES Users(id) ON DELETE CASCADE
);
```

2.3 Advanced Features

Automatic GPA Calculation

Implemented a trigger TR_UpdateGradeTable that automatically:

- Updates student GPAs when grades are entered
- Calculates passed and failed credit hours
- Removes course registrations upon grade entry

3. SQL Queries

3.1 Data Analysis Queries

Student Course Load

```
SELECT u.first_name, u.last_name, c.id as course_id, c.name as course_name,
    s.day, s.start_time, s.end_time
FROM Users u
JOIN Course_registered cr ON u.id = cr.student_id
JOIN Section s ON cr.section_id = s.id
JOIN Courses c ON s.course_id = c.id
WHERE u.id = 1;
```

Department Enrollment Statistics

```
SELECT d.name as department_name, COUNT(u.id) as student_count
FROM Department d
LEFT JOIN Users u ON d.id = u.major
```

```
WHERE u.role = 'Student'
GROUP BY d.id, d.name;
```

3.2 Performance Analysis

GPA Distribution Query

```
SELECT
  CASE
    WHEN gpa >= 4.5 THEN '4.5-5.0'
    WHEN gpa >= 4.0 THEN '4.0-4.49'
    WHEN gpa >= 3.5 THEN '3.5-3.99'
    WHEN gpa >= 3.0 THEN '3.0-3.49'
    WHEN gpa >= 2.5 THEN '2.5-2.99'
    WHEN gpa >= 2.0 THEN '2.0-2.49'
    ELSE 'Below 2.0'
  END as gpa_range,
  COUNT(*) as student_count
FROM Grade
GROUP BY CASE
  WHEN gpa >= 4.5 THEN '4.5-5.0'
  -- ... [rest of the CASE statement]
  END
ORDER BY gpa_range DESC;
```

4. Challenges and Solutions

1. **Complex GPA Calculation**
    - Challenge: Automating GPA updates when new grades are entered
    - Solution: Created a sophisticated trigger that recalculates GPA, passed, and failed hours
2. **Course Prerequisites**
    - Challenge: Ensuring proper course sequencing

    - Solution: Implemented a separate Course_prerequisite table with appropriate constraints

3. **Scheduling Conflicts**
    - Challenge: Preventing double-booking of rooms and time slots
    - Solution: Created ValidDays table and implemented proper foreign key constraints

5. Future Improvements

1. Add indexing for performance optimization
2. Implement stored procedures for common operations
3. Add data archiving mechanism for graduated students
4. Create views for commonly used query combinations

6. Individual Contributions

- Mohammed Ragab: Led database schema design
- Youssef Mohammed: Implemented core tables and triggers
- Ahmed Ayman: Implemented core tables and triggers
- Ahmed Hesham: Implemented core tables and triggers
- Ahmed Harmas: Schema design and ER diagrams
- Hady Sameh: Schema design and ER diagrams