SAIT Student Enrollment Database: A Comprehensive Case Study on Database Design

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Abstract

Efficient management of student enrollment processes is crucial for modern educational institutions. This article presents a comprehensive database system developed for the Southern Alberta Institute of Technology (SAIT), designed to streamline enrollment, scheduling, and payment tracking. By modeling real-world relationships among students, instructors, classrooms, courses, and financial transactions, the system ensures data integrity, accessibility, and administrative efficiency. The database leverages relational design principles to support dynamic queries and reporting, enabling informed decision-making across departments. This case study illustrates how structured data systems can modernize and optimize institutional workflows in the academic sector.

Introduction

Managing student enrollment at a large educational institution involves more than just recording names and assigning classes. It requires the seamless integration of diverse data—student preferences, instructor schedules, classroom availability, course offerings, and financial transactions—into a cohesive system. Without a well-designed data infrastructure, this complexity often leads to administrative delays, poor communication, and inefficiencies that affect both students and staff.

To address these challenges, our team developed a robust relational database system tailored to the needs of the Southern Alberta Institute of Technology (SAIT). The goal was to create a centralized platform capable of tracking student enrollments, aligning schedules, managing instructor assignments, and monitoring tuition payments. By capturing and connecting critical entities through normalized tables and well-defined relationships, the database provides a scalable solution that simplifies operations and enhances data visibility.

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This article details the system's architecture, design rationale, and implementation strategy. It demonstrates how effective database solutions can solve common pain points in academic administration while enabling better planning, reporting, and student support.

Purpose and Objectives

Purpose

The mission of the SAIT Student Enrollment Database project is to design and implement a comprehensive, relational database system that streamlines student enrollment processes. The system aims to enhance operational efficiency by integrating critical academic and administrative data—enabling accurate scheduling, real-time tracking of course and payment details, and improved decision-making for both students and institutional staff.

Objectives

1. **Streamline Enrollment Management**
   Establish a centralized system to efficiently handle student enrollments, ensuring accurate associations with courses, instructors, classrooms, and payment records.

2. **Enhance Scheduling Alignment**
   Facilitate alignment between student and instructor schedule preferences to minimize conflicts and maximize course accessibility.

3. **Optimize Elective Selection**
   Support elective course selection based on real-time data, improving the adaptability and personalization of student academic paths.

4. **Improve Data Connectivity**
   Create meaningful relational links between key entities (Students, Courses, Instructors, Classrooms, Payments, Enrollment) to promote data consistency and reduce

redundancy.

5. **Support Administrative Decision-Making**
   Enable dynamic queries and reporting that aid academic planners and administrators in making informed, data-driven decisions.

6. **Provide Scalable Infrastructure**
   Design the database to support growth, allowing for additional student intakes, expanded course offerings, and new institutional requirements without compromising performance.

Entity Identification

The following section outlines each table used in the SAIT Student Enrollment Database, along with a breakdown of their attributes and what they represent.

1. STUDENTS

This table stores essential biographical and academic preference data for each student.

- **Student_ID (PK)**: Unique identifier assigned to each student.
- **First_Name**: Student's given name.
- **Last_Name**: Student's family or surname.
- **Gender**: Student's gender identity.
- **Date_Of_Birth**: Birth date used for age verification and eligibility.
- **Mobile_Number**: Student's contact phone number.
- **Email_Address**: Student's primary email for communication.

- **Schedule_Preference**: Preferred time slot for attending classes (e.g., morning, evening).
- **Course_ID (FK)**: Links the student to the course they are primarily enrolled in.

```
select * from Students;
```

ults Messages

Student_Id	First_Name	Last_Name	Gender	Date_Of_Birth	Mobile_Number	Email_Address	Schedule_Preference	Course_Id
1001	Alice	Smith	F	2002-04-15	403-555-0123	alice.smith@email.com	Morning	SAIT101
1002	Bob	Johnson	M	2001-09-22	403-555-0456	bob.johnson@email.com	Afternoon	SAIT102
1003	Charlie	Williams	M	2003-01-10	403-555-0789	charlie.williams@email.com	Evening	SAIT103
1004	Diana	Brown	F	2002-07-30	403-555-0110	diana.brown@email.com	Morning	SAIT101
1005	Ethan	Davis	M	2001-12-05	403-555-0220	ethan.davis@email.com	Afternoon	SAIT104
1006	Alicia	Patrick	F	1997-12-01	587-234-7890	alicia.patrick@email.com	Morning	SAIT105
1007	Josh	Brown	M	1999-01-01	603-555-3456	josh.brown@email.com	Afternoon	SAIT101
1008	Reece	Young	M	2000-03-07	603-456-1236	reece.young@email.com	Evening	SAIT106

2. COURSES

Defines academic programs available at SAIT and the departments offering them.

- **Course_ID (PK)**: Unique identifier for each course.
- **Course_Name**: Name/title of the course (e.g., Data Science, Web Development).
- **Department_Name**: Department under which the course is offered (e.g., Computer Science, Business).

```
6
7   select * from Courses;
8
9
10
11
```

Results Messages

	Course_Id	Course_Name	Department_Name
1	SAIT101	Data Science	School of Digital Technology
2	SAIT102	Supply Chain Management	School of Business & Leadership
3	SAIT103	Project Management	School of Business & Leadership
4	SAIT104	Product Management	School of Business & Leadership
5	SAIT105	Digital Marketing	School of Business & Leadership
6	SAIT106	IT Management	School of Business & Leadership
7	SAIT107	International Business Management	School of Business & Leadership
8	SAIT108	Software Development	School of Digital Technology
9	SAIT109	Cybersecurity	School of Digital Technology

3. CLASSROOMS

Stores physical classroom data where instructional activities occur.

- **Room_Number (PK)**: Unique identifier for each classroom.
- **Building_Name**: Name of the building where the classroom is located.
- **Course_ID (FK)**: Indicates which course is conducted in the classroom.

```
7    select * from classrooms;
8
9
10
11
```

Results Messages

	Room_Number	Building_Name	Course_Id
	131	E.H Crandell	SAIT101
	132	E.H Crandell	SAIT102
	133	E.H Crandell	SAIT103
	134	E.H Crandell	SAIT104
	135	E.H Crandell	SAIT105
	136	E.H Crandell	SAIT106
	137	E.H Crandell	SAIT107
	138	E.H Crandell	SAIT108
	139	E.H Crandell	SAIT109

4. INSTRUCTORS

Captures instructor-related data including preferences and course assignments.

- **Instructor_ID (PK)**: Unique identifier for each instructor.
- **Instructor_Name**: Full name of the instructor.
- **Email_Address**: Professional email used for official communication.
- **Mobile_Number**: Contact number for internal coordination.
- **Schedule_Preference**: Preferred teaching schedule (e.g., weekdays, weekends).
- **Course_ID (FK)**: Indicates the course the instructor is assigned to teach.

```
7   select * from instructors;
8
9
10
11
```

Results Messages

Instructor_Id	Instructor_Name	Email_Address	Mobile_Number	Schedule_Preference	Course_Id
501	Junaid Qazi	junaid.qazi@sait.ca	403-777-1001	Morning	SAIT101
502	John Marks	john.marks@sait.ca	403-777-2202	Afternoon	SAIT104
503	Sarah Edward	sarah.edward@sait.ca	403-777-3303	Evening	SAIT105
504	Emily Turner	emily.turner@sait.ca	403-777-1001	Morning	SAIT106
505	Hussein Chaitani	hussein.chaitani@sait.ca	587-345-2678	Evening	SAIT102
506	Sarah Chein	sarah.chen@sait.ca	678-987-1123	Afternoon	SAIT107
507	Muzaffar Sultan	Muzaffar.Sultan@sait.ca	654-900-3456	Evening	SAIT103
508	Garth Roberts	Garth.Roberts@sait.ca	587-234-5678	Morning	SAIT108
509	Richard Clayton	richard.clayton@sait.ca	403-789-9076	Afternoon	SAIT109

5. PAYMENT

Tracks student financial transactions related to course enrollments.

- **Payment_ID (PK)**: Unique identifier for each payment transaction.
- **Student_ID (FK)**: Links the payment to a specific student.
- **Payment_Date**: Date when the payment was made.
- **Payment_Amount**: Total amount paid by the student.
- **Payment_Mode**: Method of payment (e.g., credit card, bank transfer, cash).
- **Payment_Status**: Indicates whether the payment is completed, pending, or failed.

```
6
7   select * from Payment;
8
9
10
11
```

Results Messages

	Payment_Id	Student_Id	Payment_Date	Payment_Amount	Payment_Mode	Payment_Status
1	201	1001	2024-12-10	23000.00	Debit Card	Completed
2	202	1002	2024-12-11	25000.00	E-Transfer	Completed
3	203	1003	2024-12-12	27000.00	Credit Card	Completed
4	204	1004	2024-12-13	23000.00	Cheque	Completed
5	205	1005	2024-02-10	25000.00	Debit Card	Completed
6	206	1006	2024-02-11	27000.00	E-Transfer	Completed

6. ENROLLMENT

Serves as a central linking table for student course registration and related records.

- **Enrollment_ID (PK)**: Unique ID for each enrollment record.
- **Student_ID (FK)**: Indicates which student is enrolled.
- **Course_ID (FK)**: Course associated with the enrollment.
- **Instructor_ID (FK)**: Instructor assigned for the enrolled course.
- **Room_Number (FK)**: Classroom where the course will be conducted.
- **Payment_ID (FK)**: Payment record associated with the enrollment.
- **Enrollment_Date**: Date when the enrollment was processed.

```
select * from enrollment;
```

lts Messages

Enrollment_Id	Student_Id	Course_Id	Instructor_Id	Room_Number	Payment_Id	Enrollment_Date
19830	1001	SAIT101	501	131	201	2024-09-10
19831	1002	SAIT102	505	132	202	2024-09-11
19832	1003	SAIT103	507	133	203	2024-09-12
19833	1004	SAIT104	502	134	204	2024-09-13
19834	1005	SAIT105	503	135	205	2024-09-14
19835	1006	SAIT106	504	136	206	2024-09-15
19836	1007	SAIT107	506	137	207	2024-09-16

Entity-Relationship (E-R) Diagram

The E-R Diagram visually represents how different entities in the SAIT Student Enrollment Database are interconnected. This schema is designed to ensure data consistency, enforce referential integrity, and enable flexible querying across the student enrollment process.

🔗 Key Relationships and Their Cardinalities:

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1. Students ↔ Enrollment

- **Type:** One-to-Many
- **Explanation:** A single student can enroll in multiple courses (e.g., across terms or for retakes), but each enrollment record refers to only one student.
- **Foreign Key:** Student_Id in Enrollment references Student_Id in Students

2. Courses ↔ Enrollment

- **Type:** One-to-Many
- **Explanation:** Each course can have many students enrolled, but each enrollment entry corresponds to one specific course.
- **Foreign Key:** Course_Id in Enrollment references Course_Id in Courses

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3. Instructors ↔ Enrollment

- **Type:** One-to-Many
- **Explanation:** One instructor may teach several students across different enrollment records, but each enrollment is tied to a specific instructor.
- **Foreign Key:** Instructor_Id in Enrollment references Instructor_Id in Instructors

4. Classrooms ↔ Enrollment

- **Type:** One-to-Many
- **Explanation:** A classroom can host multiple class sessions (enrollments), but each enrollment uses one classroom.
- **Foreign Key:** Room_Number in Enrollment references Room_Number in Classrooms

5. Students ↔ Payment

- **Type:** One-to-Many

- **Explanation:** A student can make multiple payments over time (e.g., installments), but each payment belongs to one student.

- **Foreign Key:** Student_Id in Payment references Student_Id in Students

6. Payment ↔ Enrollment

- **Type:** One-to-One (contextual, per enrollment)

- **Explanation:** Each enrollment is associated with one specific payment. Although students may make multiple payments, each payment in the context of enrollment is unique.

- **Foreign Key:** Payment_Id in Enrollment references Payment_Id in Payment

7. Courses ↔ Instructors

- **Type:** One-to-Many

- **Explanation:** A course can have multiple instructors over time, but each instructor record is tied to a single course.

- **Foreign Key:** Course_Id in Instructors references Course_Id in Courses

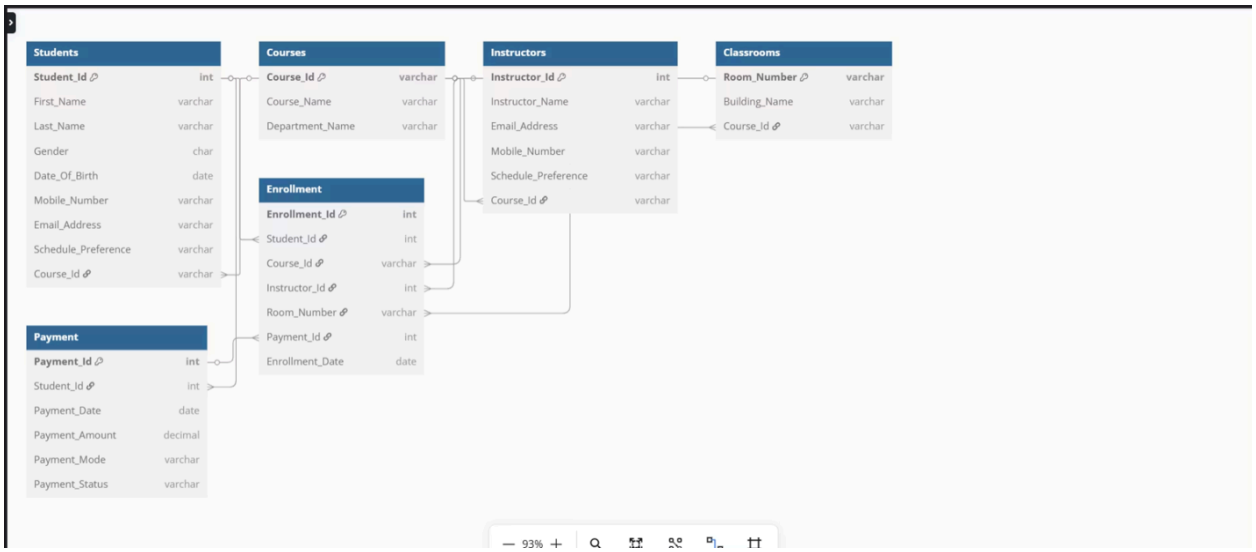
---

8. Courses ↔ Classrooms

- **Type:** One-to-Many

- **Explanation:** A course can be assigned to different classrooms, but each classroom entry is associated with one course.

- **Foreign Key:** Course_Id in Classrooms references Course_Id in Courses



Queries

To fully harness the power of the SAIT Student Enrollment Database, several JOIN queries were developed. These queries demonstrate how key data points (students, courses, instructors, payments, and classrooms) are interconnected and can be used to produce actionable insights.

1. Complete Enrollment Details Query

- Displays complete enrollment records including student info, course name, instructor, classroom, and payment details.

- Excellent for generating enrollment reports or dashboards.

[Harshit Patel (Linkedin)]

```
SELECT
  s.Student_Id,
  s.First_Name,
  s.Last_Name,
  c.Course_Name,
  i.Instructor_Name,
  cl.Room_Number,
  cl.Building_Name,
  e.Enrollment_Date,
  p.Payment_Amount,
  p.Payment_Mode,
  p.Payment_Status
FROM Enrollment e
JOIN Students s ON e.Student_Id = s.Student_Id
JOIN Courses c ON e.Course_Id = c.Course_Id
JOIN Instructors i ON e.Instructor_Id = i.Instructor_Id
JOIN Classrooms cl ON e.Room_Number = cl.Room_Number
JOIN Payment p ON e.Payment_Id = p.Payment_Id;
```

ults Messages

Student_Id	First_Name	Last_Name	Course_Name	Instructor_Name	Room_Number	Building_Name	Enrollment_Date	Payment_Amount	Payment_Mode	Payment_
1001	Alice	Smith	Data Science	Junaid Qazi	131	E.H Crandell	2024-09-10	23000.00	Debit Card	Compl
1002	Bob	Johnson	Supply Chain Management	Hussein Chaitani	132	E.H Crandell	2024-09-11	25000.00	E-Transfer	Compl
1003	Charlie	Williams	Project Management	Muzaffar Sultan	133	E.H Crandell	2024-09-12	27000.00	Credit Card	Compl
1004	Diana	Brown	Product Management	John Marks	134	E.H Crandell	2024-09-13	23000.00	Cheque	Compl
1005	Ethan	Davis	Digital Marketing	Sarah Edward	135	E.H Crandell	2024-09-14	25000.00	Debit Card	Compl
1006	Alicia	Patrick	IT Management	Emily Turner	136	E.H Crandell	2024-09-15	27000.00	E-Transfer	Compl
1007	Josh	Brown	International Business Management	Sarah Chein	137	E.H Crandell	2024-09-16	23000.00	Credit Card	Compl
1008	Reece	Young	Software Development	Garth Roberts	138	E.H Crandell	2024-09-17	25000.00	Cheque	Compl
1009	Sabrina	King	Cybersecurity	Richard Clayton	139	E.H Crandell	2024-09-18	27000.00	Debit Card	Compl
1010	Neil	Mckenzie	Data Science	Alexis Nunes	131	E.H Crandell	2024-09-19	23000.00	E-Transfer	Compl

2. Students with Matching Instructor Schedules

- Finds students whose schedule preference aligns with their instructor.
- Useful for minimizing scheduling conflicts.

```
33   select s.Student_Id, s.First_Name, s.Last_Name, c.Schedule_Preference, c.Course_Id, c.Instructor_Name
34   FROM Students s
35   INNER JOIN instructors c
36   ON s.Course_Id = c.Course_Id
37   AND s.Schedule_Preference = c.Schedule_Preference;
38
```

Results Messages

	Student_Id	First_Name	Last_Name	Schedule_Preference	Course_Id	Instructor_Name
1	1001	Alice	Smith	Morning	SAIT101	Junaid Qazi
2	1002	Bob	Johnson	Afternoon	SAIT102	Shiva Kondapalli
3	1003	Charlie	Williams	Evening	SAIT103	Muzaffar Sultan
4	1004	Diana	Brown	Morning	SAIT101	Junaid Qazi
5	1005	Ethan	Davis	Afternoon	SAIT104	John Marks
6	1007	Josh	Brown	Afternoon	SAIT101	Alexis Nunes
7	1008	Reece	Young	Evening	SAIT106	Nick Caron
8	1015	Bethany	Watts	Morning	SAIT104	Fola Alibi
9	1016	Scott	Hewitt	Morning	SAIT103	Jan Cuthberson
10	1017	Glenn	Mitchell	Evening	SAIT102	Hussein Chaitani
11	1019	Alison	Mitchell	Afternoon	SAIT102	Shiva Kondapalli
12	1021	Claudine	Bridger	Morning	SAIT104	Fola Alibi

3. Total Enrollments Per Course

- Counts how many students are enrolled in each course.
- Helps in evaluating course popularity and capacity planning.

```
SELECT
  c.Course_Name,
  COUNT(e.Student_Id) AS Total_Enrolled
FROM Enrollment e
JOIN Courses c ON e.Course_Id = c.Course_Id
GROUP BY c.Course_Name;
```

ults Messages

Course_Name	Total_Enrolled
Data Science	4
Supply Chain Management	3
Project Management	3
Product Management	3
Digital Marketing	3
IT Management	3
International Business Management	3
Software Development	3
Cybersecurity	3

4. Total Revenue Per Course

- Summarizes total income generated by each course.

- Useful for budgeting and financial reporting.

```sql
SELECT
  c.Course_Name,
  SUM(p.Payment_Amount) AS Total_Revenue
FROM Enrollment e
JOIN Payment p ON e.Payment_Id = p.Payment_Id
JOIN Courses c ON e.Course_Id = c.Course_Id
GROUP BY c.Course_Name;
```

Results Messages

	Course_Name	Total_Revenue
1	Data Science	92000.00
2	Supply Chain Management	75000.00
3	Project Management	81000.00
4	Product Management	69000.00
5	Digital Marketing	75000.00
6	IT Management	81000.00
7	International Business Management	69000.00
8	Software Development	75000.00
9	Cybersecurity	81000.00

5. Student Distribution by Schedule Preference

- Shows how students are distributed across Morning, Afternoon, and Evening slots.
- Helps in managing classroom and instructor assignments.

```
33  select s.Student_Id, s.First_Name, s.Last_Name, c.Schedule_Preference, c.Course_Id, c.Instructor_Name
34  FROM Students s
35  INNER JOIN instructors c
36  ON s.Course_Id = c.Course_Id
37  AND s.Schedule_Preference = c.Schedule_Preference;
38
```

Results Messages

	Student_Id	First_Name	Last_Name	Schedule_Preference	Course_Id	Instructor_Name
1	1001	Alice	Smith	Morning	SAIT101	Junaid Qazi
2	1002	Bob	Johnson	Afternoon	SAIT102	Shiva Kondapalli
3	1003	Charlie	Williams	Evening	SAIT103	Muzaffar Sultan
4	1004	Diana	Brown	Morning	SAIT101	Junaid Qazi
5	1005	Ethan	Davis	Afternoon	SAIT104	John Marks
6	1007	Josh	Brown	Afternoon	SAIT101	Alexis Nunes
7	1008	Reece	Young	Evening	SAIT106	Nick Caron
8	1015	Bethany	Watts	Morning	SAIT104	Fola Alibi
9	1016	Scott	Hewitt	Morning	SAIT103	Jan Cuthberson
10	1017	Glenn	Mitchell	Evening	SAIT102	Hussein Chaitani
11	1019	Alison	Mitchell	Afternoon	SAIT102	Shiva Kondapalli
12	1021	Claudine	Bridger	Morning	SAIT104	Fola Alibi

Challenges in Implementation

1. Data Integrity & Validation

- Ensuring consistent and accurate data input across multiple entities (e.g., course assignment, instructor preferences) can be complex, especially with real-time student enrollments.

2. Handling Schedule Conflicts

- Matching student and instructor schedule preferences while assigning classrooms without conflict requires additional logic or scheduling algorithms beyond basic SQL.

3. Scalability

- As the number of students, courses, and semesters increases, the system must be optimized to handle larger volumes of transactions and queries efficiently.

4. Real-World Complexity

- Real scenarios may involve more flexible or irregular rules (e.g., part-time courses, multi-instructor classes, elective rotations), which can require customizations not initially accounted for.

5. Security and Privacy

- Managing student data (DOB, contact, payment info) demands strong data protection measures to comply with privacy laws and institutional policies.

6. User Interface Integration

- The back-end database must be integrated with a user-friendly interface (e.g., web portal or mobile app) for students, instructors, and administrators to interact with the system effectively.

Conclusion

The SAIT Student Enrollment Database presents a structured, scalable solution to streamline and modernize the academic enrollment process. By organizing critical entities such as students, courses, instructors, classrooms, and payments into a relational framework, the system not only improves operational efficiency but also empowers decision-makers with real-time, data-driven insights.

This database model ensures data integrity, supports flexible scheduling, and provides a solid foundation for future enhancements such as attendance tracking, grading systems, and semester-based planning. Its modular design allows it to grow with the institution's needs, making it a long-term investment in academic infrastructure.

Harshit Patel (Linkedin)

Note to Readers

This article represents the current state of the SAIT Student Enrollment Database project. However, it is a work in progress. Further edits, refinements, and feature expansions will be documented and published in future updates. Readers and contributors are encouraged to revisit this article for the latest developments and improvements.