

San Francisco Bay University
Data Modeling and Implementation Techniques

On-Campus Accommodation Office

Natnael Haile - 20007
Prachi Sethi - 19963

Instructor - Pragati Dharmale
Date - 9 December 2023





Introduction

- Efficient management of student accommodation is crucial to creating a productive learning environment.
- The On-Campus Accommodation Office oversees housing logistics, student and administrative operations.
- This paper focuses on a comprehensive database designed for the office's accommodation management needs.



Introduction

- The database facilitates information flow, enhances decision-making, and streamlines housing management.
- Staff details, financial transactions, leases, student records, and accommodation options require a automated system.
- A relational database schema is proposed to address the diverse aspects of student accommodation on campus.



Inefficiencies in Student Accommodation Management

- Difficulty tracking student housing
- Lack of system to manage leases, invoices, and maintenance
- Need to accommodate more students efficiently



Introducing the On-Campus Accommodation Management System

Key features of the system

- Comprehensive data management
- Streamlined administrative tasks
- Enhanced data accuracy and integrity



Assumptions

- All students are enrolled to the minimum required credit hours.
- All students, staff members, and advisors have valid phone numbers, email addresses, and addresses.
- All students have at least one next-of-kin person registered.
- Students who have been in the accommodation for a year will have their renewal status changed to false.
- All students must have a major and a minor course they are enrolled in.



Sample form designs

Student Form

Banner Number: _____

Name: _____

Home Address: _____

Phone Number

Email: _____

DOB: _____

Gender: _____

Category: _____

Course Number : _____

Major: _____

Minor : _____

Status: _____

Nationality: _____

Special Needs: _____

Additional Comments

Student Flats

Apartment Number: _____ Address: _____

No of Rooms: _____

Residence halls

Name: _____ Address: _____

Telephone: _____ Manager: _____

Rooms

Room No: _____ Place No: _____

Rent Rate: _____



Sample form designs

Rooms

Room No: _____

Place No: _____

Rent Rate: _____

Leases

Lease No: _____

Duration of lease: _____

Student Name: _____

Banner Number: _____

Place Number: _____

Room Number: _____

Address: _____

Start Date: _____

End Date: _____

Lease Renewal: _____

Inspections Form

Inspection ID: _____

Satisfactory Condition: _____

Staff Name: _____

Additional Comments: _____

Inspection Date: _____

Lease Number: _____

Residence Staff Form

Staff ID: _____

Staff Number: _____

Student First Name: _____

Staff Email: _____

Student Last Name: _____

Staff Home Address: _____

Staff Date Of Birth: _____

Staff Gender: _____

Position: _____

Location: _____



Sample form designs

Next Of Kin Form

Next Of Kin ID: _____

Student Banner Number: _____

Next Of Kin Name: _____

Relationship: _____

Next Of Kin Address: _____

Contact Phone Number: _____

Advisers Form

Adviser ID: _____

Adviser Full Name: _____

Position: _____

Department Name: _____

Internal Phone Number: _____

Adviser Email: _____

Room Number: _____

Invoices Form

Invoice Number: _____

Room Number: _____

Lease Number: _____

Address: _____

Semester: _____

Date Paid: _____

Payment Due: _____

Method Of Payment: _____

Student First Name: _____

Date First Reminder: _____

Student Last Name: _____

Date Second Reminder: _____

Student Banner Number: _____

Place Number: _____

Courses Form

Course Number: _____

Instructor Email: _____

Course Title: _____

Instructor Room Number: _____

Course Instructor: _____

Instructor Room Number: _____



Sample report formats

Active Leases Report

DATE OF REPORT: MM/DD/YYYY

Lease Number

Lease Duration

Renewal Status

Banner Number

Place number

Room number

Student Report

DATE OF REPORT: MM/DD/YYYY

Banner Number

Courses enrolled

Major

Minor

Advisor



Sample report formats

Active Invoice Report

DATE OF REPORT: MM/DD/YYYY

Invoice Number Lease Number Semester Room Number Address

Payment Due Date Paid Method Of Payment Student Name Student

Banner Number Place Number Date First Reminder Date Second

Reminder

Inspections Report

DATE OF REPORT: MM/DD/YYYY

Inspection ID Staff Name Inspection Date Satisfactory Condition

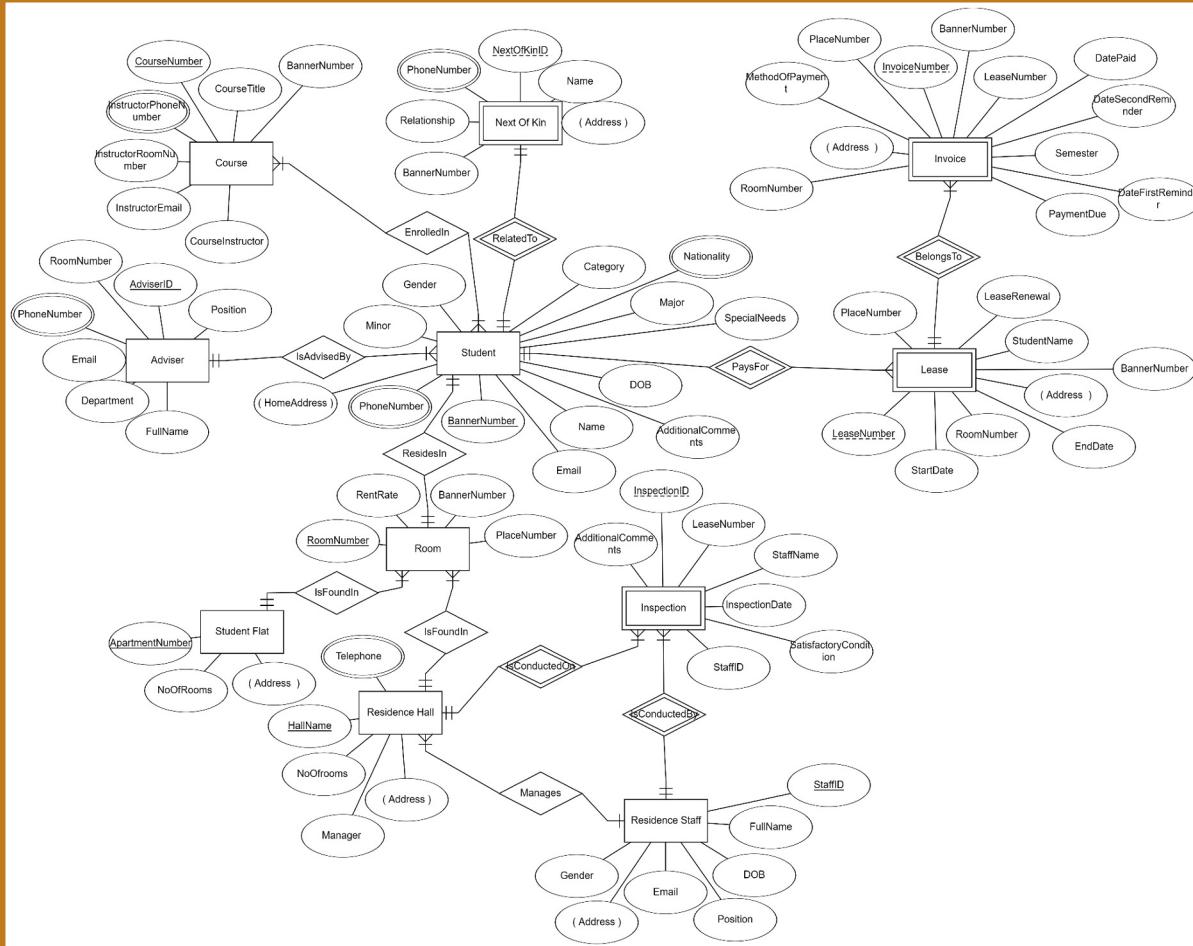
Additional Comments Lease Number



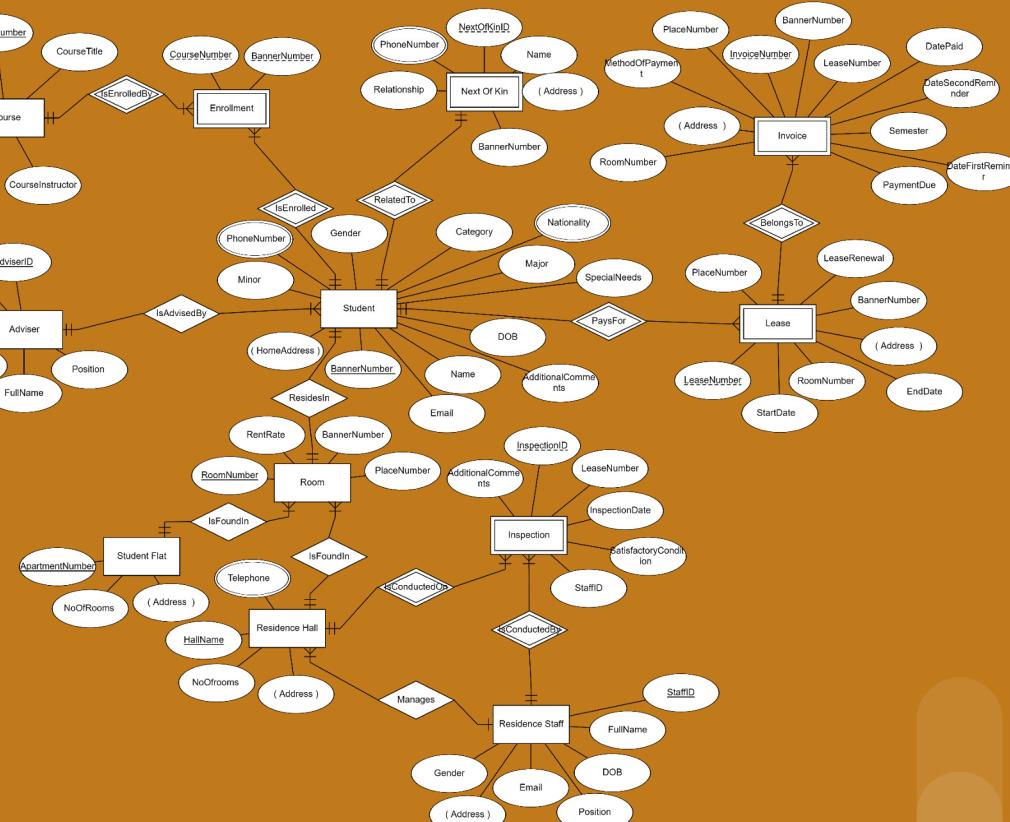
Data Dictionary

1. NextOfKin	3. ResidenceStaff	5. StudentFlats	8. Student	10. Invoice
● NextOfKinID	● StaffID	● FlatNumber	● BannerNumber	● InvoiceNumber
● Name	● FullName	● NoOfrooms	● Name	● Semester
● BannerNumber	● DOB	● Address	● DOB	● PaymentDue
● Relationship	● Position	● StaffID	● Email	● RoomNumber
● Address	● Email	● RoomNumber	● Gender	● DatePaid
● PhoneNumber	● Gender	● RentRate	● Minor	● MethodOfPayment
2. Advisor	● Address	● PlaceNumber	● Major	● BannerNumber
● AdviserID	4. ResidenceHall	● HallName	● SpecialNeeds	● PlaceNumber
● Position	● HallName	● NoOfrooms	● AdditionalComments	● DateFirstReminder
● RoomNumber	● NoOfrooms	● Telephone	● Category	● DateSecondReminder
● FullName	● Telephone	● Address	● Nationality	● Address
● Department	● Address	● StaffID	● PhoneNumber	● LeaseNumber
● Email	● StaffID	12. Enrollment	● HomeAddress	11. Course
● PhoneNumber		● CourseNumber	● RoomNumber	● CourseNumber
		● BannerNumber	● AdviserID	● CourseTitle
				● CourseInstructor
				● InstructorEmail
				● InstructorRoomNumber
				● InstructorPhoneNumber

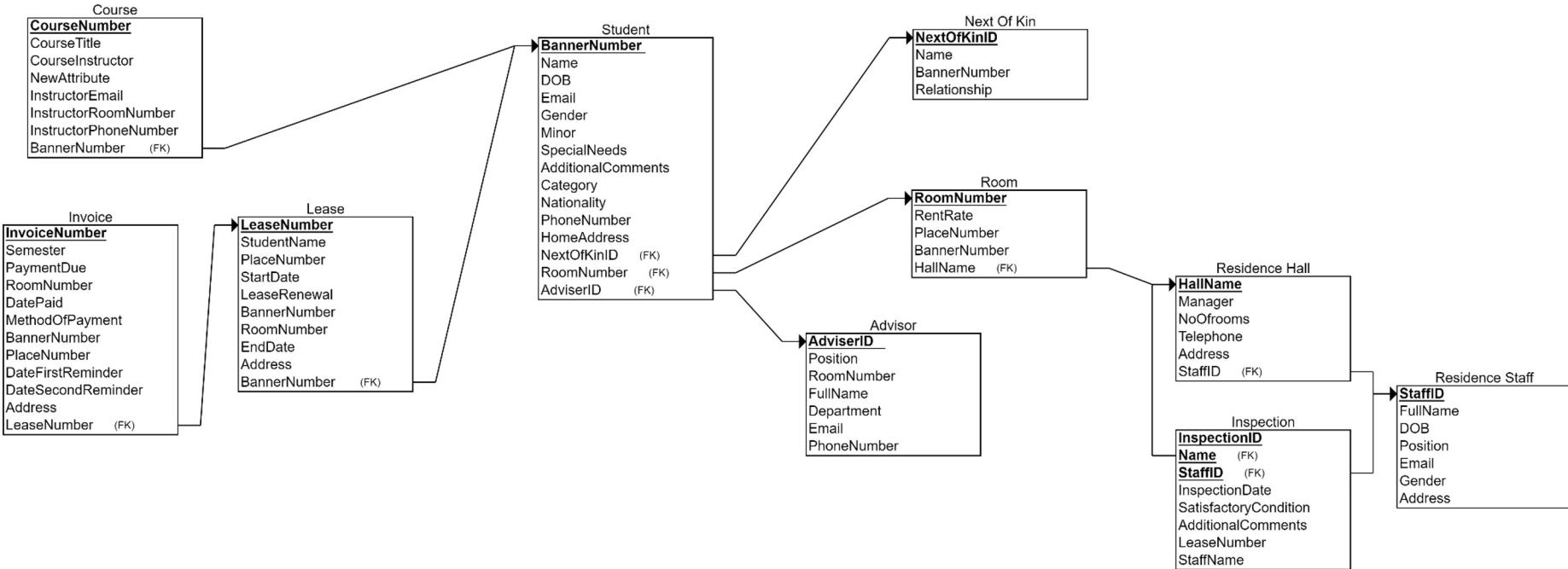
Building a Robust Data Model (initial data model)



Building a Robust Data Model (data model after normalization)



Relational Schema



Snapshots of the implementation



Sample Queries

```
CREATE TABLE Student  
(  
    BannerNumber CHAR(6) NOT NULL,  
    Name VARCHAR(100),  
    DOB DATE,  
    Email VARCHAR(50),  
    Gender VARCHAR(6),  
    Minor VARCHAR(25),  
    Major VARCHAR(25),  
    SpecialNeeds VARCHAR(255),  
    AdditionalComments VARCHAR(255),  
    Category VARCHAR(25),  
    Nationality VARCHAR(50),  
    PhoneNumber VARCHAR(20),  
    HomeAddress VARCHAR(100),  
    RoomNumber CHAR(6) NOT NULL,  
    AdviserID CHAR(6) NOT NULL,  
    PRIMARY KEY (BannerNumber),  
    FOREIGN KEY (RoomNumber) REFERENCES  
    Room(RoomNumber),  
    FOREIGN KEY (AdviserID) REFERENCES Advisor(AdviserID)  
);
```

```
INSERT INTO Student (BannerNumber, Name, DOB, Email, Gender, Minor, Major,  
SpecialNeeds, AdditionalComments, Category, Nationality, PhoneNumber,  
HomeAddress, RoomNumber, AdviserID) VALUES  
    (11111, 'Liam Turner', '2000-07-12', 'liam@example.com', 'Male', 'Physics', 'Math',  
    NULL, 'Enjoys stargazing', 'Undergraduate', 'USA', '555-8888', '101 Cedar St',  
    'A101', 104),
```

Database Snapshots

Student Table

BannerNumber	Name	DOB	Email	Gender	Minor	Major	SpecialNeeds	AdditionalComments	Category	Nationality	PhoneNumber	HomeAddress	RoomNum	AdviserID
101010	Sophie Harris	1995-02-10	sophie@example.com	Female	Mathematics	Machine Learning	HULL	Mathematics lover	Graduate	UK	555-7777	1010 Birch St	F606	103
111111	Liam Turner	2000-07-12	liam@example.com	Male	Physics	Math	HULL	Enjoys stargazing	Undergraduate	USA	555-8888	101 Cedar St	A101	104
222222	Ava Harris	1999-04-25	ava@example.com	Female	Computer Science	Cybersecurities	HULL	Loves coding	Undergraduate	Canada	555-9999	202 Birch St	D404	105
333333	Mason Clark	2001-01-08	mason@example.com	Male	Mathematics	Physics	HULL	Aspiring mathematician	Undergraduate	UK	555-1010	303 Maple St	C303	106
444444	Sophia White	1998-08-20	sophia@example.com	Female	Biology	Chemistry	HULL	Passionate about ecology	Undergraduate	USA	555-1111	404 Oak St	B202	107
555555	Oscar Green	1997-03-05	oscar@example.com	Male	Psychology	Arts	Special accommoda... HULL	Anxiety	Graduate	Canada	555-2222	505 Pine St	J1010	108
666666	Emma Turner	2002-10-18	emma@example.com	Female	Networking	Math	HULL	Interested in robotics	Undergraduate	USA	555-3333	606 Elm St	I909	109
777777	Henry Harris	1996-05-30	henry@example.com	Male	Chemistry	Biology	HULL	Chemistry enthusiast	Undergraduate	UK	555-4444	707 Cedar St	H808	110
888888	Grace Clark	1994-12-15	grace@example.com	Female	Physics	Biotech	Special accommoda... HULL	Hearing Impairment	Graduate	USA	555-5555	808 Pine St	E505	101
999999	Oliver Turner	1993-09-28	oliver@example.com	Male	Computer Science	Quantum Computing	HULL	Tech enthusiast	Graduate	Canada	555-6666	909 Elm St	G707	102
000000	Patricia Green	1996-06-15	patricia@example.com	Female	Mathematics	Statistics	HULL	Statistical analysis	Graduate	UK	555-0000	1000 Birch St	H1000	103

Advisor Table



Database Snapshots

NextOfKin Table

	NextOfKinID	Name	BannerNumber	Relationship
▶	1	John Doe	88888	Parent
	10	Emma Turner	77777	Parent
	2	Jane Smith	99999	Sibling
	3	Bob Johnson	10101	Guardian
	4	Alice Turner	11111	Parent
	5	Charlie Harris	22222	Sibling
	6	Eva Clark	33333	Guardian
	7	David White	44444	Parent
	8	Sophia Davis	55555	Sibling
	9	Oscar Green	66666	Guardian
*	HULL	HULL	HULL	HULL

Room Table

	RoomNumber	RentRate	PlaceNumber	HallName
▶	A101	500	1	Hall A
	B202	600	2	Hall B
	C303	550	3	Hall C
	D404	520	4	Hall D
	E505	620	5	Hall E
	F606	580	6	Hall F
	G707	530	7	Hall G
	H808	610	8	Hall H
	I909	560	9	Hall I
	J1010	540	10	Hall J
*	HULL	HULL	HULL	HULL

StudentFlats Table

	FlatNumber	NoOfrooms	Address	StaffID
▶	1	10	40 Cedar St	201
	10	13	130 Maple St	210
	2	12	50 Birch St	202
	3	8	60 Pine St	203
	4	15	70 Elm St	204
	5	9	80 Maple St	205
	6	11	90 Oak St	206
	7	7	100 Pine St	207
	8	14	110 Cedar St	208
	9	10	120 Birch St	209
*	HULL	HULL	HULL	HULL



Database Snapshots

ResidenceStaff Table

	StaffID	FullName	DOB	Position	Email	Gender	Address
▶	201	Alice Johnson	1990-05-15	Manager	alice@example.com	Female	123 Main St
	202	Bob Williams	1985-08-22	Supervisor	bob@example.com	Male	456 Oak St
	203	Eva Davis	1992-11-10	Resident Assistant	eva@example.com	Female	789 Pine St
	204	Charlie Turner	1988-03-05	Residence Coordinator	charlie@example.com	Male	101 Cedar St
	205	Sophia Harris	1995-09-18	Residence Manager	sophia@example.com	Female	202 Birch St
	206	Oscar Clark	1998-12-20	Resident Assistant	oscar@example.com	Male	303 Maple St
	207	Emma White	1993-04-15	Residence Supervisor	emma@example.com	Female	404 Oak St
	208	Henry Green	1996-07-30	Residence Coordinator	henry@example.com	Male	505 Pine St
	209	Grace Turner	1991-10-12	Residence Manager	grace@example.com	Female	606 Elm St
	210	Oliver Harris	1987-02-25	Resident Assistant	oliver@example.com	Male	707 Cedar St
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Course Table

	CourseNumber	CourseTitle	CourseInstructor	InstructorEmail	InstructorRoomNumber	InstructorPhoneNumber	BannerNumber
▶	1004	Organic Chemistry	Prof. Turner	prof.turner@example.com	105	555-7777	11111
	1005	Linear Algebra	Dr. Harris	dr.harris@example.com	206	555-8888	22222
	1006	Software Engineering	Prof. Clark	prof.clark@example.com	307	555-9999	33333
	1007	Ecology and Environment	Dr. White	dr.white@example.com	408	555-1010	44444
	1008	Cognitive Psychology	Prof. Green	prof.green@example.com	509	555-1111	55555
	1009	Robotics	Dr. Turner	dr.turner@example.com	110	555-2222	66666
	1010	Organic Chemistry Lab	Prof. Harris	prof.harris@example.com	211	555-3333	77777
	1011	Computer Networks	Dr. Clark	dr.clark@example.com	312	555-4444	88888
	1012	Advanced Robotics	Prof. White	prof.white@example.com	413	555-5555	99999
	1013	Human Physiology	Dr. Green	dr.green@example.com	514	555-6666	101010
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Enrollment Table

	CourseNumber	BannerNumber
▶	1004	11111
	1004	22222
	1004	33333
	1004	44444
	1004	55555
	1006	11111
	1006	22222
	1006	33333
	1006	66666
	1006	77777
	1008	101010
	1008	11111
	1008	55555
	1008	88888
	1008	99999



Database Snapshots

Invoice Table

	InvoiceNumber	Semester	PaymentDue	RoomNumber	DatePaid	MethodOfPayment	BannerNumber	PlaceNumber	DateFirstReminder	DateSecondReminder	Address	LeaseNumber
▶	1	Spring 2023	500	A101	2023-01-15	Credit Card	11111	4	2023-02-01	2023-02-15	101 Cedar St	1
	10	Spring 2023	540	F606	NULL	NULL	101010	3	2024-02-01	2024-02-15	1010 Birch St	10
	2	Spring 2023	600	D404	NULL	NULL	22222	5	2023-03-01	2023-03-15	202 Birch St	2
	3	Spring 2023	550	C303	NULL	NULL	33333	6	2023-04-01	2023-04-15	303 Maple St	3
	4	Spring 2023	520	B202	2023-05-01	Bank Transfer	44444	7	2023-06-01	2023-06-15	404 Oak St	4
	5	Spring 2023	620	J1010	2023-07-01	Credit Card	55555	8	2023-08-01	2023-08-15	505 Pine St	5
	6	Spring 2023	580	I909	NULL	NULL	66666	9	2023-09-01	2023-09-15	606 Elm St	6
	7	Spring 2023	530	H808	2023-10-01	Cheque	77777	10	2023-11-01	2023-11-15	707 Cedar St	7
	8	Spring 2023	610	E505	NULL	NULL	88888	1	2023-12-01	2023-12-15	808 Pine St	8
	9	Spring 2023	560	G707	NULL	NULL	99999	2	2024-01-01	2024-01-15	909 Elm St	9
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

ResidenceHall Table

	HallName	NoOfrooms	Telephone	Address	StaffID
▶	Hall A	50	555-1111	10 Elm St	201
	Hall B	40	555-2222	20 Maple St	202
	Hall C	30	555-3333	30 Oak St	203
	Hall D	35	555-4444	40 Pine St	204
	Hall E	45	555-5555	50 Cedar St	205
	Hall F	38	555-6666	60 Birch St	206
	Hall G	28	555-7777	70 Maple St	207
	Hall H	42	555-8888	80 Oak St	208
	Hall I	31	555-9999	90 Pine St	209
	Hall J	48	555-1010	100 Elm St	210
*	NULL	NULL	NULL	NULL	NULL

Database Snapshots

Lease Table

Inspection Table

Enhancing the existing database

Introducing Normalization

The Course and Student tables have a many-to-many relationship, meaning a student can take many courses and a course can have many students enrolled. To handle this relationship in the database, we need to create a linking table.

To handle this many-to-many relationship between Course and Student:

1. Create a Linking Table:

Create a new table named "Enrollment".

Add two foreign key columns to the "Enrollment" table:

BannerNumber (foreign key referencing the Student table's primary key)

CourseNumber (foreign key referencing the Course table's primary key)

2. Update the Existing Tables:

Student Table: No additional changes are needed.

Course Table: Banner Number needs to be dropped from the table.

Functional dependencies-

1. NextOfKin

$\text{NextOfKinID} \rightarrow \text{Name, BannerNumber, Relationship}$

2. Advisor

$\text{AdviserID} \rightarrow \text{Position, RoomNumber, FullName, Department, Email, PhoneNumber}$

3. ResidenceStaff

$\text{StaffID} \rightarrow \text{FullName, DOB, Position, Email, Gender, Address}$

4. ResidenceHall

$\text{HallName} \rightarrow \text{NoOfrooms, Telephone, Address, StaffID}$

5. StudentFlats

$\text{FlatNumber} \rightarrow \text{NoOfrooms, Address, StaffID}$

6. Room

$\text{RoomNumber} \rightarrow \text{RentRate, PlaceNumber, HallName}$

7. Inspection

$\text{InspectionID} \rightarrow \text{InspectionDate, SatisfactoryCondition, AdditionalComments, LeaseNumber, StaffName}$

StaffName is dependent on StaffId, which is non key attribute, hence the updated normalized form would be

InspectionID → InspectionDate, SatisfactoryCondition, AdditionalComments, LeaseNumber

8. Student

BannerNumber → Name, DOB, Email, Gender, Minor, SpecialNeeds, AdditionalComments, Category, Nationality, PhoneNumber, HomeAddress, NextOfKinID, RoomNumber, AdviserID

9. Lease

LeaseNumber → StudentName, PlaceNumber, StartDate, LeaseRenewal, BannerNumber, RoomNumber, EndDate, Address

StudentName is dependent on StaffId, which is non key attribute, hence the updated normalized form would be

LeaseNumber → PlaceNumber, StartDate, LeaseRenewal, BannerNumber, RoomNumber, EndDate, Address

10. Invoice

InvoiceNumber → Semester, PaymentDue, RoomNumber, DatePaid, MethodOfPayment, BannerNumber, PlaceNumber, DateFirstReminder, DateSecondReminder, Address, LeaseNumber

11. Course

CourseNumber → CourseTitle, CourseInstructor, InstructorEmail, InstructorRoomNumber, InstructorPhoneNumber, BannerNumber



Indexing

The DDL statements to create the indexes are shown below-

```
CREATE INDEX idx_student_bannernumber ON Student(BannerNumber);
CREATE INDEX idx_nextofkin_bannernumber ON NextOfKin(BannerNumber);
CREATE INDEX idx_room_roomnumber ON Room(RoomNumber);
CREATE INDEX idx_residencehall_hallname ON ResidenceHall(HallName);
CREATE INDEX idx_studentflats_staffid ON StudentFlats(StaffID);
CREATE INDEX idx_lease_bannernumber ON Lease(BannerNumber);
CREATE INDEX idx_lease_roomnumber ON Lease(RoomNumber);
CREATE INDEX idx_invoice_roomnumber ON Invoice(RoomNumber);
CREATE INDEX idx_invoice_bannernumber ON Invoice(BannerNumber);
CREATE INDEX idx_invoice_leasenumber ON Invoice(LeaseNumber);
CREATE INDEX idx_enrollment_coursenumber ON Enrollment(CourseNumber);
CREATE INDEX idx_enrollment_bannernumber ON Enrollment(BannerNumber);
```



Non-routine requests

a) Calculate the average rent for rooms in each residence hall. The query for this request is as follows:

```
354      -- Problem 1
355 •  SELECT r.HallName, AVG(r.RentRate) AS AvgRent
356      FROM Room r
357      GROUP BY r.HallName;
```

The screenshot shows a database query results grid. At the top, there is a code editor window containing the SQL query. Below it is a results grid with a header row and seven data rows. The grid has three columns: HallName, AvgRent, and a navigation column.

	HallName	AvgRent
▶	Hall A	500
	Hall B	600
	Hall C	550
	Hall D	520
	Hall E	620
	Hall F	580
	Hall G	530

Non-routine requests

- b) Count the number of students from each nationality.

```
361 •      SELECT Nationality, COUNT(*) AS StudentCount  
362      FROM Student  
363      GROUP BY Nationality;
```

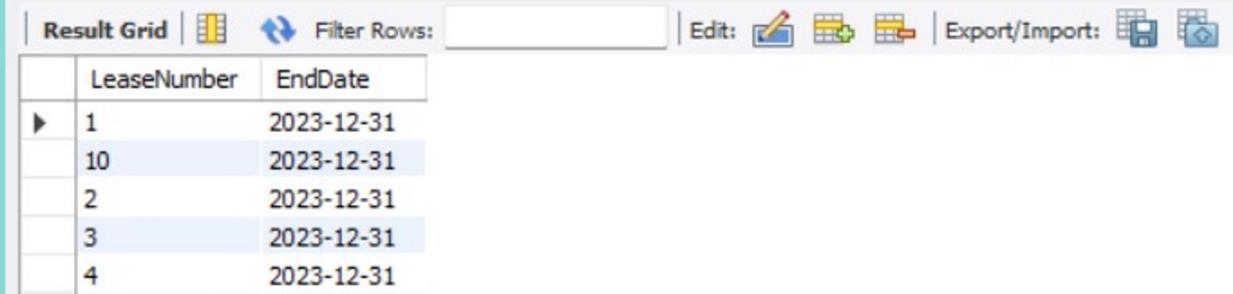
Result Grid | Filter Rows: Export: Wrap Ce

	Nationality	StudentCount
▶	UK	3
	USA	4
	Canada	3

Non-routine requests

c) Identify leases that are ending within the next month.

```
367 •   SELECT LeaseNumber, EndDate  
368     FROM Lease  
369     WHERE EndDate BETWEEN NOW() AND DATE_ADD(NOW(), INTERVAL 1 MONTH);
```



The screenshot shows a MySQL Workbench interface with a query editor and a results grid. The query editor contains the following SQL code:

```
367 •   SELECT LeaseNumber, EndDate  
368     FROM Lease  
369     WHERE EndDate BETWEEN NOW() AND DATE_ADD(NOW(), INTERVAL 1 MONTH);
```

The results grid displays the following data:

	LeaseNumber	EndDate
▶	1	2023-12-31
	10	2023-12-31
	2	2023-12-31
	3	2023-12-31
	4	2023-12-31

Non-routine requests

- d) List students with any specified special needs or accommodations.

```
373 •      SELECT BannerNumber, Name, SpecialNeeds  
374        FROM Student  
375        WHERE SpecialNeeds IS NOT NULL;
```

Result Grid | Filter Rows: | Edit: | Export:

	BannerNumber	Name	SpecialNeeds
▶	55555	Oscar Green	Special accommodation for anxiety
	88888	Grace Clark	Special accommodation for hearing impairment
*	NULL	NULL	NULL

Non-routine requests

- e) Display the students whose lease has been renewed.

```
379 •      SELECT l.BannerNumber BannerNumber, s.Name StudentName, s.Category Category  
380      FROM Lease l, Student s  
381      WHERE l.BannerNumber=s.BannerNumber AND l.LeaseRenewal=TRUE;
```

	BannerNumber	StudentName	Category
▶	11111	Liam Turner	Undergraduate
	33333	Mason Clark	Undergraduate
	55555	Oscar Green	Graduate
	77777	Henry Harris	Undergraduate
	99999	Oliver Turner	Graduate



Facilitating Day-to-Day Activities

- Data entry, update, and deletion
- Student data management
- Lease agreement management
- Invoice generation and tracking
- Accommodation information management
- Inspection reporting



Solving Key Challenges

- Ensuring data integrity and accuracy
- Efficient lease tracking
- Streamlining invoice management
- Facilitating inspection monitoring



Expanding Functionality and Adapting to Future Needs

- Automated reminder systems for lease renewals
- Advanced analytics for predicting accommodation demand
- Detailed housing availability information



Challenges Faced

- Data Integration: Combining data from disparate sources with different formats and standards.
- Meeting Deadlines: Balancing multiple tasks and delivering the project on time within budget.
- Scope Creep: Managing changes to the project requirements and keeping them aligned with the original goals.



Career skills obtained

- Communication Skills: Communicating project progress, challenges, and solutions clearly.
- Project Management Skills: Planning, organizing, and executing a project while adhering to deadlines and budgets.
- Analytical Skills: Analyzing data to identify patterns and trends and draw meaningful conclusions.



Career skills obtained

- Technical Skills: Proficiency in designing and creating a full-fledged database using MySQL.
- Problem-Solving: Identifying and solving complex problems related to data management and system development.



Conclusion

- Enhanced Efficiency: Streamlined administrative tasks, improved data accuracy, and increased efficiency in managing student accommodation.
- Improved Decision-Making: Access to real-time data and insights to support informed decision-making about housing availability and student needs.

Q&A

Thank You !