

Indian Institute of Technology Gandhinagar



Transport Management System

CS432 Assignment 1
29th January, 2024

Moon Macrosystems: Group Members

Ayush Modi, 21110039
Mithil Pechimuthu, 21110129
Vedant Kumbhar, 21110234
Shreesh Agarwal, 21110198
Anushk Bhana, 21110031
Jivitesh Soneji, 21110088
Abhishek Mandlik, 21110122

Contents

1. Responsibility of Group 1	iii
2. Responsibility of both Group 1 and Group 2	v
3. Responsibility of Group 2	xiii
4. Contributions	xxiii

1. Responsibility of Group 1

Answer 2.1:

2.1.1:

Our database system serves as the backbone of a comprehensive Transport Management System tailored for the IITGN campus. Primarily, it facilitates the seamless booking of institute bus seats, ensuring efficient utilization of transportation resources along with aiming at streamlining and optimizing the logistics and transportation activities within the campus.

The impact of the database is multifaceted. It enhances overall campus transportation efficiency, reduces logistical challenges, and provides a user-friendly interface for stakeholders. Students and staff benefit from a hassle-free booking experience, while administrators gain valuable insights into transport utilization trends through robust record-keeping.

Stakeholders involved include students, faculty, and administrative staff responsible for managing transportation logistics. The functional requirements encompass seat availability tracking, booking confirmation, and comprehensive record-keeping of all the transportation activities of the campus for auditing and future planning. The database system is also designed to scale with the institution's growing needs, ensuring sustained effectiveness in managing campus transportation services.

Overall, the transport management database system serves as a pivotal tool for enhancing the various transportation operations within the institute.

2.1.2:

We reached out to Prof. Abhijit Mishra to gather information about the current campus situation. Our inquiry included several key questions:

1. Is there currently an implemented database management system for transporta-

tion within the institute?

2. Could you provide insights into the various transportation facilities associated with the institute?
3. Are there any specific challenges in managing the transportation system currently?
4. Do drivers have individual IDs, like Driver ID, that are unique to them?
5. How many ambulances are available on campus for emergency situations?
6. Regarding mess and shop services, are these outsourced, and is there a system in place to monitor their vehicle activities?

Additionally, we conducted interviews with shop owners to understand the frequency of goods arrival, transportation processes, and related aspects. Integrating the responses received from Prof. Abhijit Mishra and the shop owners, we meticulously designed the Entity-Relationship 1 diagram to reflect the details of the institute's transportation and logistics landscape.

2. Responsibility of both Group 1 and Group 2

Answer 2.2:

2.2.1.1:

The various Entities involved in our system are as follows:

1. **Vehicle:** Represents the transport vehicles used for to-and-fro in the campus.
2. **Driver:** Represents the individuals responsible for driving the transport vehicles.
3. **Route:** Represents the specific routes that vehicles follow within the campus along with the schedule.
4. **Parking Space:** Represents the parking space for vehicles inside the campus.
5. **Staff:** Represents the IITGN Staff.
6. **Faculty:** Represents the IITGN Faculty.
7. **Student:** Represents the IITGN students.
8. **Insurance:** Represents the insurance details of the vehicle.
9. **Goods:** Represents the goods which are delivered on campus.
10. **User:** Represents any driver, staff, faculty, or student logging into the portal.
11. **Shops:** Represents the shops within the campus to which goods are delivered.

The attributes of the Entities mentioned above are:

(* represents multivalued attributes)

Strong Entity Sets:

The Primary Keys have been underlined.

1. Vehicle :

- license_plate_number
- capacity
- vehicle_type
- owned_by

2. Driver :

- driver_license_number
- email_id
- name
 - first_name
 - last_name
- phone_number
- vehicles_driven : (License plate number) *
- bank_details
 - account_number
 - ifsc_number
 - branch_name
- date_of_joining

3. Parking Space :

- location
- capacity

4. Staff :

- email_id
- name
 - first_name
 - last_name
- phone_number

5. Faculty :

- email_id
- name
 - first_name
 - last_name
- phone_number

6. Student :

- email_id
- name
 - first_name
 - last_name
- phone_number
- guardian_number

7. Insurance :

- insurance_id
- vehicle_registration_number
- person name
 - first_name
 - last_name
- start_date
- end_date
- expenses_covered

8. User

- email_id
- password

9. Shops :

- name_of_shop
- location
- owner_name

Weak Entity Sets:

Discriminants are represented by dashed underline.

1. Route : Vehicle is the Identifying entity set

- starting_station (Location)
- ending_station (Location)
- start_time
- estimated_time_of_travel
- route_distance

2. Goods : Shops is the Identifying entity set

- from
- to
- date_and_time_of_transport

The relationships are listed below:

1. Staff, Faculty - **PrivateOwnership** - Vehicle (One to Many): A faculty/staff member can have multiple numbers of vehicles.

Participation: Partial on both sides.

2. Driver - **DrivenBy**- Vehicle (Many to many): A driver can be associated with multiple transport vehicles, and a vehicle can be associated with multiple drivers.

Participation: Total on both sides.

3. Vehicle - **TransportationLog** - Route (Many to many): A vehicle can be associated with multiple routes, and a route can be associated with multiple vehicles.

TransportationLog:: Descriptive Attributes:

Time

To/From Location

Driver Name

No. of passengers

Entry/Exit

Participation: Total on both sides.

4. Vehicle - **VehicleInsurance** - Insurance (One to one): A vehicle can be associated with only one insurance, and vice-versa.

Participation: Partial on Vehicle side, Partial (as we have created a common entity for both people and vehicles) on Insurance side.

5. Vehicle - AllocatedParking- Parking Space (Many to one): A vehicle can be allocated only one Parking Space, and a parking space could have multiple vehicles.

Participation: Partial on both sides.

6. Driver, faculty, staff, student - Login - User (One to one): The mentioned entities can all be associated with only one login detail, and vice-versa.

Participation: Total on both sides.

7. Shops - ShopVehicles - Vehicle (One - Many): A shop can own many vehicles, and a particular vehicle would be associated with only one shop.

Participation: Total on Shops side, Partial on Vehicle side.

8. Goods - GoodsTransported - Vehicle (One - one): A goods entity can be transported by only one vehicle, and a particular vehicle would only deliver one entity of goods. (Because goods are associated and differentiated by time)

Participation: Total on Goods side, Partial on Vehicle side.

9. User - Booking - Vehicle (Many - Many): A user can book many vehicles, and a particular vehicle would be booked by many users.

Participation: Partial on both sides.

2.2.1.2:

The examples and justification of each point from c to g in Design Requirements is as follows:

c)

Primary Key: All the strong entity sets have a primary key. A primary key is an attribute that could uniquely identify a tuple within an entity set.

Examples:

License Plate Number is the primary key of the entity set Vehicle as it can uniquely identify any tuple within the Vehicle Entity set,

Drivers' License Number is the primary key of the entity set Driver as it can uniquely identify any tuple within the Driver Entity set.

Foreign Key: An attribute of an entity set which is the primary key of a different entity set.

Example: License Plate Number is a foreign key of the entity set Insurance as it is the primary key of the set Vehicle and also present as an attribute of the Insurance entity set.

d)

There are many one-to-one relationships in our database.

Examples:

VehicleInsurance is a one-to-one relationship between Vehicle and Insurance entities.
Reason: One vehicle can have one insurance in our database and similarly, any one insurance can only be associated with a single vehicle.

GoodsTransported is a one-to-one relationship between Goods and Vehicle entities.
Reason: In our database goods are differentiated based on time, please refer to the attributes of goods. Thus, any goods entity can be delivered only by only one vehicle, and a particular vehicle would only deliver one entity of goods.

e)

We have 2 one-to-many relationships, and 1 many-to-one relationship.

Examples:

One-to-many example: PrivateOwnership is a one to many relationship that indicates the vehicle privately owned by a faculty or staff member. A faculty member may own many vehicles but it is not necessary for all the faculty members/staff to have vehicles.

Many-to-One example: ShopVehicles is a many-to-one relationship that defines how many vehicles are owned by the shops. A shop can have many vehicles but one vehicle is not owned by many shops.

f)

We have 3 many-to-many relationships.

Example: DrivenBy is a many-to-many relationship that exists between Driver and Vehicle entities. Many vehicles can be associated with a single driver and a driver can drive multiple vehicles.

g)

We have mentioned the participation constraint for all the relationships.

Examples:

Login relationship that exists between driver, faculty, staff and students and user provides the login for them. Here we can see that there is total participation from both the entities. Each member will have an account and all the accounts will be associated with some member.

Booking defines the relationship between User and Vehicle that facilitates the booking process for the users. Not everyone might book the vehicles and not all vehicles will be booked. Hence from both the sides we will have partial participation.

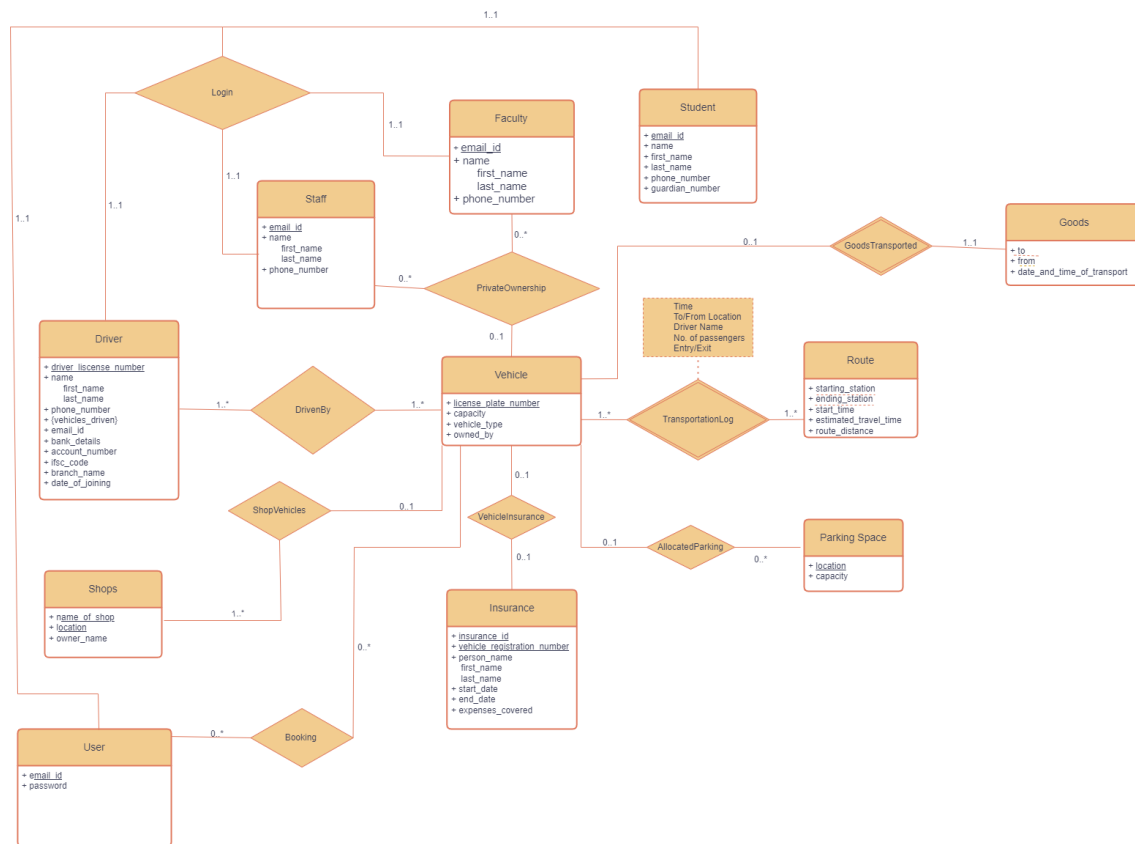


Figure 1: E-R Diagram

2.2.2:

The ER diagram is shown above in Figure 1.

Here is also the link to the PNG file of the ER diagram:

Link: ER DIAGRAM

3. Responsibility of Group 2

Answer 2.3:

The answers to all the sections 2.3.1 through 2.3.4 are together given below: (The mapping cardinalities are shown clearly in the ER diagram.)

Faculty	
PK	<u>email_id varchar(50) NOT NULL</u>
	first_name varchar(20) NOT NULL
	last_name varchar(20)
	phone_number varchar(10) NOT NULL

Faculty

Primary Key - email_id

Constraints:

email_id - NOT NULL (email must always be provided for every student)

first_name - NOT NULL (Each student must be associated with a name)

phone_number - NOT NULL (Every student should provide their contact details)

phone_number - UNIQUE (No two students should have the same contact number)

Students	
PK	<u>email_id varchar(20) NOT NULL</u>
	first_name varchar(20) NOT NULL
	last_name varchar(20)
	phone_number varchar(10)
	guardian_number varchar(10)

Students

Primary Key - email_id

Constraints:

email_id - NOT NULL (email must always be provided for every faculty)

first_name - NOT NULL (Each faculty must be associated with a name)

Staff	
PK	<u>email_id varchar(50) NOT NULL</u>
	first_name varchar(20) NOT NULL
	last_name varchar(20)
	phone_number varchar(10) NOT NULL

Staff

Primary Key - email_id

Constraints: email_id - NOT NULL (email must always be provided for every staff member)

first_name - NOT NULL (Each staff member must be associated with a name)

phone_number - NOT NULL (Every staff member should provide their contact details)

phone_number - UNIQUE (No two staff members should have the same contact number)

Driver	
PK	<u>driver_license_number varchar(16) NOT NULL</u>
	first_name varchar(20) NOT NULL
	last_name varchar(20)
	phone_number varchar(10) NOT NULL
	date_of_joining date
	driver_license_number varchar(16)
	account_number varchar(16) NOT NULL
	ifsc_code varchar(16) NOT NULL
	branch_name varchar(16) NOT NULL

Driver

Primary Key - driver_license_number

Constraints:

first_name - NOT NULL (Each driver must be associated with a name)

phone_number - NOT NULL (Every driver should provide their contact details)

phone_number - UNIQUE (No two drivers should have the same contact number)

account_number, ifsc_code, branch_name - NOT NULL (Required details for the institute to be able to transfer salary to the driver)

DrivenBy	
PK,FK1	<u>driver_license_number varchar(16) NOT NULL</u>
PK, FK2	<u>license_plate_number varchar(50) NOT NULL</u>

DrivenBy

Primary Key - driver_license_number, license_plate_number

Foreign Key - driver_license_number, license_plate_number

Constraints:

driver_license_number - NOT NULL (Each driver should have drivers license to be eligible to drive)

license_plate_number - NOT NULL (Each driver should give the license plate number they are driving)

Vehicle	
PK	<u>license_plate_number</u> varchar(50) NOT NULL
	capacity int owned_by varchar(16) NOT NULL vehicle_type varchar(20)

Vehicle

Primary Key - license_plate_number

Constraints:

license_plate_number - NOT NULL (Each vehicle is identified using the license plate number and hence is necessary to be provided)

owned_by - NOT NULL (Each vehicle should have owner name for better identification)

Shops	
PK	<u>name_of_shop</u> varchar(50) NOT NULL
PK	<u>location</u> varchar(10) NOT NULL
	owner_name varchar(20) NOT NULL

Shops

Primary Key - name_of_shop, location

Constraints:

name_of_shop - NOT NULL (Each shop should provide a name)

owned_name- NOT NULL (Each shop should have owner name for better identification)

location - NOT NULL (Location of the shop should be provided to locate shop)

User	
PK	<u>username</u> varchar(20) NOT NULL
	password varchar(12) NOT NULL

Users

Primary key - username

Constraints:

username - NOT NULL (Each person should provide a name)

password - NOT NULL (Each user must provide a password)

password -UNIQUE (Every user must have a unique password)

password -CHECK (Each password should have an uppercase letter, a special character and a minimum of 8 characters)

Goods	
PK, FK1	<u>name_of_shop</u> varchar(50) NOT NULL
PK, FK2	location varchar(10) NOT NULL
	Date_and_time_of_transport date NOT NULL
	From varchar(20)
	To varchar (20)

Goods

Primary key - name_of_shop, location

Foreign key- name_of_shop, location (Since it is the primary key of other entity)

Constraints:

name_of_shop - NOT NULL (Each shop should provide a name)

Date_and_time_of_transport - NOT NULL (Time logistics of transport should always be provided)

location - NOT NULL (Location of delivery should be provided to be able to successfully complete the transportation)

Route	
PK	<u>starting_station varchar(20)</u> NOT NULL
PK	<u>ending_station varchar(20)</u> NOT NULL
	start_time date
	estimated_travel_time varchar(6)
	route_distance int

Route

Primary key - starting_station, ending_station

Constraints:

starting_station, ending_station - NOT NULL (Starting location and ending location needs to be provided in order to perform proper transportation and delivery)

Insurance	
PK	<u>insurance_id varchar(18)</u> NOT NULL
PK	<u>license_plate_number varchar(16)</u> NOT NULL
	first_name varchar(20)
	last_name varchar(20)
	start_date varchar(20)
	end_date varchar(20)
	expenses_covered int

Insurance

Primary key - insurance_id, license_plate_number

Foreign key- license_plate_number (Since it is the primary key of other entity)

Constraints:

insurance_id - NOT NULL (insurance_id should be provided for unique identification)

license_plate_number - NOT NULL (Each vehicle is identified using the license plate number and hence is necessary to be provided)

first_name - NOT NULL (Name should be provided for better identification)

start_date, end_date - NOT NULL (Important to know the validity of the insurance)

Parking_Space	
PK	<u>location varchar(100)</u> NOT NULL
	capacity int

Parking_Space

Primary key - location

Constraints:

location - NOT NULL (Parking location is needed to properly locate the place of parking space)

Booking	
PK, FK1	<u>username varchar(20)</u> NOT NULL
PK, FK2	<u>license_plate number</u> varchar(50) NOT NULL

Booking

Primary Key - email_id, license_plate_number

Foreign key -email_id, license_plate_number(Since it is the primary key of other entity)

Constraints: email_id - NOT NULL (email_id must always be provided for every user)
license_plate_number - NOT NULL (Each vehicle is identified using the license plate number and hence is necessary to be provided)

VehicleInsurance	
PK, FK1	<u>insurance id</u> varchar(18) NOT NULL
PK, FK2	<u>license_plate number</u> varchar(50) NOT NULL

VehicleInsurance

Primary Key - insurance_id, license_plate_number

Foreign key -insurance_id, license_plate_number(Since it is the primary key of other entity)

Constraints:

insurance_id - NOT NULL (insurance_id should be provided for unique identification)

license_plate_number - NOT NULL (Each vehicle is identified using the license plate number and hence is necessary to be provided)

GoodsTransported	
PK, FK1	<u>license_plate number varchar(16)</u> NOT NULL
	to varchar (20)
	from varchar (20)

GoodsTransport

Primary Key - license_plate_number

Foreign key - license_plate_number (Since it is the primary key of other entity)

Constraints:

license_plate_number - NOT NULL (Each vehicle is identified using the license plate number and hence is necessary to be provided)

ShopVehicles	
PK, FK1	<u>name_of_shop varchar(50)</u> NOT NULL
PK, FK2	<u>location varchar(10)</u> NOT NULL
PK, FK3	<u>license_plate_number</u> varchar(50) NOT NULL

ShopVehicles

Primary key: name_of_shop, location, license_plate_number

Foreign key: name_of_shop, location, license_plate_number

Constraints:

license_plate_number - NOT NULL (Each vehicle is identified using the license plate)

name_of_shop - NOT NULL (Each shop should provide a name)

location - NOT NULL (Location of parking should be provided)

Login	
PK, FK1	<u>driver_license_number varchar(16)</u> NOT NULL
PK, FK2	<u>email_id varchar(50)</u> NOT NULL

Login

Primary key - driver_license_number, email_id

Foreign key - driver_license_number, email_id (Since it is the primary key of other entity)

Constraints:

email_id - NOT NULL (email must always be provided for every faculty)

driver_license_number - NOT NULL (Each driver should have drivers license to be eligible to drive)

AllocatedParking	
PK, FK1	<u>license_plate_number varchar(16)</u> NOT NULL
FK2	location varchar(100) NOT NULL

AllocatedParking

Primary Key - license_plate_number

Foreign key - license_plate_number (Since it is the primary key of other entity)

Constraints:

license_plate_number - NOT NULL (Each vehicle is identified using the license plate) number and hence is necessary to be provided)

location - NOT NULL (Location of parking should be provided)

TransportationLog	
PK, FK1	<u>license_plate_number varchar(16)</u> NOT NULL
PK, FK2	<u>starting_station varchar(20)</u> NOT NULL
PK FK3	<u>ending_station varchar(20)</u> NOT NULL
	Time time
	To/From Location varchar(10) NOT NULL
	Driver Name varchar(20) NOT NULL
	No. of passengers int
	Entry/Exit varchar(5) NOT NULL

TransportationLog

Primary Key: license_plate_number, starting_station, ending_station

Foreign Key: license_plate_number, starting_station, ending_station

Constraints:

license_plate_number - NOT NULL (Each vehicle is identified using the license plate)

starting_station,ending_station - NOT NULL (Starting location and ending location needs to be provided in order to perform proper transportation and delivery)

To/From Location varchar(10) NOT NULL (There would be a To and from location associated with each transport)

driver Name varchar(20) NOT NULL (Name of the driver is required)

Entry/Exit varchar(5) NOT NULL (whether the journey is an entry or exit is required)

PrivateOwnership	
PK, FK1	<u>license_plate_number</u> varchar(10) NOT NULL
FK2	email_id varchar(50) NOT NULL

PrivateOwnership

Primary key - license_plate_number

Foreign key - email_id (Since it is the primary key of other entity)

Constraints:

license_plate_number - NOT NULL (Each vehicle is identified using the license plate number and hence is necessary to be provided)

email_id - NOT NULL (email must always be provided for every staff member)

4. Contributions

Name	Roll Number	Contribution
Anushk Bhana (G2)	21110031	Q2.2, Documentation
Mithil Pechimuthu (G2)	21110129	Q2.2, Q2.3, Documentation
Shreesh Agrawal (G2)	21110198	Q2.2, Q2.3, Documentation
Ayush Modi (G1)	21110039	Q2.1, Q2.2.1, Documentation
Abhishek Mandlik (G2)	21110122	Q2.2, Q2.3
Vedant Kumbhar (G1)	21110234	Q2.1, Q2.2, Q2.3
Jivitesh Soneji (G1)	21110088	Q2.1, Q2.2.1