DUTCHESS COUNTY BUS TRANSPORTATION SYSTEM

MSCS_542L_256_23S

The Four-Ce

Marist College School of Computer Science and Mathematics

Submitted To: Dr. Reza Sadeghi

11-01-2023

PROJECT REPORT OF DUTCHESS COUNTY BUS TRANSPORTATION SYSTEM

Team Name

The Four-Ce

Team Members

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DESCRIPTION OF TEAM MEMBERS

1. **Sindhuja Ravikanth**

   I attained my bachelor's degree in computer science from Keshav Memorial Institute of Technology in 2022. I worked as a Software Developer in TCP Wave for 1 year 9 months. I have come to Marist College for my master's degree in computer science. I am proficient in Java, MySQL, and JavaScript.I am here to develop my skills and develop better products.

2. **Shanmukha Chowdary Nalla**

   I graduated from the Indian Institute of Technology Design and Manufacturing, Jabalpur in the year 2022. I started working in the software field in the 7th semester at Merkle Company as an Analyst and then as a Salesforce Marketing Cloud Developer till June 2023. I am a CertifiedSalesforce Marketing Cloud Developer, Email Specialist, and Machine Learning Engineer. I chose this course because it helps me enhance my skillsetin data management which is always handy.

3. **Gaurav Bapurao Sherla**

   I am an aspiring AWS and ML developer. I want to make the world a betterplace by empowering technology with the help of AI, especially in the mining sector. Where many lives are lost while mining ore from hundreds of feet beneath the earth, I have worked as an ML developer for a startup where I gained some useful insights with the help of this course I will be able to get in-depth practical knowledge about DBMS and this would help me enhance my knowledge, which can help me boost my skills for my futuregrowth.

4. **Katipally Chanakya Vardhan Reddy**

   I am Katipally Chanakya Vardhan Reddy, a Computer Science graduate from Methodist College of Engineering and Technology. Currently, I'm pursuing my Master's in MSCS with a focus on cloud computing at MaristCollege. I excel in Python, C, and C++ and have a strong background in problem-solving.

1.INTRODUCTION

In an era defined by rapid urbanization and increased reliance on public transportation, the Dutchess County Bus Transportation System (DCBTS) stands as a vital lifeline for the residents of Dutchess County, New York. TheDCBTS is an essential part of the daily lives of countless commuters, offeringa means to connect with their destinations efficiently and sustainably. However, in a world where technological advancements are reshaping how we interact with the world around us, it is imperative that our public transportation system evolves in tandem.

The objective of this project Is to propel the DCBTS Into the future by revolutionizing its digital presence and user experience. With the advent of the Information Age, accessibility to transportation information is crucial, and the current DCBTS app, while functional, requires a comprehensive overhaulto meet the needs and expectations of modern commuters.

The primary aim of this project is to develop a user-friendly DCBTS application that caters to a diverse range of users. This includes commuters seeking to efficiently plan their journeys, tourists exploring the county, and an administrator with specialized privileges to manage and optimize the system.

In this project, we are planning to simplify the process of planning daily commutes via DCPT buses for all individuals which would be user-friendly to the users of all the age groups above 10 years. With the help of our projectmodel, we want to cater our services to our users by providing them with enough data in a simplified format. Our user interface will provide the users with a menu where they can put in their source and destination locations andall the bus routes and buses in respect to their search will be displayed. Whichcan help them keep track of their bus timings and changes of any kind in thebus schedule. The users can also mark their favorite routes and buses which they mostly use for their commute and can keep track of them without any inconvenience.

2.PROJECT OBJECTIVES

The following should be supported by the system:

- The application should be able to prompt the commuters for the login detailsand allow them to change credentials with proper authentication.
- The application should allow the administrator to make changes in the user records.
- The application should provide the capability for the users or administrator to modify their contact information and profile changes with proper authentication.
- Users should be able to access information about their bus routes and buses atany point in time.
- The administrator should have access to the user’s credentials through a valid process.
- The administrator should be able to make changes in the commuting-related data.
- The application should have the capability to access separate login databaseslike commuter login and administrator login. So that they can access their respective data and use the application based on their requirements.

3.REVIEW

3.1 Dutchess County Public Transportation (DCPT) [1]

- This app is based on the whole public transportation system of Dutchess County.
- The app shows the live tracking of buses around Dutchess County.
- The buses are identified by their bus numbers with which people can identify which bus would be comfortable to board based on their schedule.
- The app also shows the user's live location, so that the user can identify whichbus is the nearest to them.
- This app shows buses in a map form.

3.2 NYC Transit: MTA Subway & Bus [2]

- This app is based on the Subways and Buses of New York.
- This app shows the best ways to get from a source to a destination around New York.
- It saves different locations as favorites.

3.3 Moovit [3]

- This app is based on all types of transport in many countries worldwide.
- It shows directions from one place to another and suggests quicker ways toget from a source to a destination irrespective of the transit type.

4.MERITS

- The DCBTS helps everyone to search for a route from source to destinationand plan their day based on the time estimation of the buses in Dutchess County.
- This application shows all the stops between the source and destination which is not available in any of the reviewed applications.
- This application will keep track of days when the buses will not be availablelike public holidays which is not available in any of the reviewed applications.
- This application will support multiple users including an Administrator.
- This application will also show the bus fare by taking into consideration theuser's age which is not available in any of the reviewed applications.

5.GITHUB REPOSITORY

https://github.com/SindhujaRavikanth2001/DBMS_Project

6.ENTITY RELATIONSHIP MODEL (ER MODEL)

An Entity Relationship (ER) Diagram is a type of flowchart thatillustrates how “entities” such as people, objects, or concepts relate to each other within a system. ER Diagrams are most often used to designor debug relational databases in the fields of software engineering, business information systems, education, and research.

We have used ERDPlus to create the ER diagram. ERDPlus is an open-source software modeling tool that supports the UML (Unified Modeling Language) framework for system and software modeling.

Entities	**Attributes**
User	UserID, FirstName, LastName, DOB, Email, PhoneNumber, Username, Password
Admin	AdminID, Username, Password, Email, PhoneNumber, EmployeeID
Bus	BusID, BusNumber, Capacity,LicensePlateNumber, BusType
Ticket Type	TicketTypeID, TypeName, Price, ValidityPeriod, Description, UserID
Payment	PaymentID, Amount, UserID, TicketTypeID, PaymentDate
Reservation	ReservationID, PaymentID, BusID, ReservationDate, NumberOfReservations
Bus Route	RouteID, StartLocation, EndLocation, BusID
Route Stop Sequence	StopSequenceID, RouteID, StopID,NumberofStops, ArrivalTime
Employee	EmployeeID, DepartmentID, FirstName,LastName, Position

Department	DepartmentID, DepartmentName, Location
Schedule	ScheduleID, BusID, RouteID, DayFlag, DepartureTime, ArrivalTime
Bus Stop	StopID, StopName, Location
Notification	NotificationID, Message, DateAndTime, UserID, AdminID, ReservationID
Holidays	HolidayID, HolidayDate, Description,NotificationID

6.1 IMPLEMENTATION OF ER DIAGRAM

Entities and Attributes:

Entity: User

Description: A table to describe the passengers in the Dutchess CountyBus Transportation System.

Attributes:

UserID – A unique identifier to identify each user. (Primary Key)FirstName – First name of the user.

LastName – Last name of the user. DOB – The date of birth of the user.Email – E-mail ID of the user.

PhoneNumber – The contact number of the user.

Username – The username of the user with which they want to login.Password – Password of the user.

Entity: Admin

Description: A table to describe the administrators who handle all the changes in the DCBTS.

Attributes:

AdminID – A unique identifier to identify each admin. (Primary Key)

Username – The username of the admin with which they want to login.Password – The password of the admin.

Email – E-mail ID of the admin.

PhoneNumber – The contact number of the admin. EmployeeID – The employee identifier of the admin.

Entity: Bus

Description: A table to describe all the properties of a bus.

Attributes:

BusID – A unique identifier to identify each bus. (Primary Key)

BusNumber – A designated bus number to identify the route of the bus.Capacity – The seating capacity of the bus.

LicensePlateNumber – The license plate number of the bus.BusType – The type of the bus. E.g.: Coach

Entity: Ticket Type

Description: A table to describe the type of each ticket.

Attributes:

TicketTypeID – A unique identifier to identify each ticket type.(Primary Key)

TypeName – Type name of the ticket. E.g.: Student ticketPrice – Price of the ticket.

ValidityPeriod – Validity period of the ticket.

Description – A description to explain which ticket applies to what age group.

UserID – (Foreign Key) to relate ticket type and user.

Entity: Payment

Description: A table to describe the payments for tickets.

Attributes:

PaymentID – A unique identifier for each payment. (Primary Key)Amount – Amount paid in the payment.

UserID – Identifier of the user who made the payment. (Foreign Key)

TicketTypeID – Identifier of the ticket type for which the payment has been made. (Foreign Key)

PaymentDate – The date on which the payment is made.

Entity: Reservation

Description: A table to describe all the seating reservations on the bus.

Attributes:

ReservationID – A unique identifier for each reservation. (Primary Key)

PaymentID – Payment identifier with which the seating reservation was made. (Foreign Key)

BusID – Identifier of the bus on which the reservation is made. (Foreign Key)

ReservationDate – The date for which the reservation is made.

NumberOfReservations – No. of reservations that have been made.

Entity: Bus Route

Description: A table to describe all the bus routes in the Dutchess County Bus Transportation System.

Attributes:

RouteID – A unique identifier to identify each route. (Primary Key)

StartLocation – Start location of the route.

EndLocation – End location of the route.

BusID – Identifier of the bus that will go on that route. (Foreign Key)

Entity: Route Stop Sequence
Description: A table to describe the route stop sequence from a source to a destination.
Attributes:
StopSequenceID – A unique identifier to identify a route stop sequence. (Primary Key)
RouteID – Route identifier to which the stop sequence is associated. (ForeignKey)
StopID – Identifier of every stop in the stop sequence. (Foreign Key)
NumberofStops – No. of stops in the route sequence.
ArrivalTime – The time at which the destination will arrive.

Entity: Employee
Description: A table to describe all the employees employed in the DCBTS.
Attributes:
EmployeeID – A unique identifier to identify each employee. (Primary Key) DepartmentID – Identifier of the department in which the employee is employed. (Foreign Key)
FirstName – First name of the employee.LastName – Last name of the employee.
Position – Designation of the employee.

Entity: Department
Description: A table to describe all the departments in the DCBTS.
Attributes:
DepartmentID – A unique identifier to identify each department. (PrimaryKey)
DepartmentName – Name of the department.Location – Location of the department.

Entity: Schedule
Description: A table to describe the bus schedule.
Attributes:
ScheduleID – An identifier to identify a schedule. (Primary Key)BusID – Identifier of the bus. (Foreign Key)
RouteID – Identifier of the routes. (Foreign Key)DayFlag – Flag to identify the day of week.
DepartureTime – Time when the bus departs.ArrivalTime – Time when the bus arrives.

Entity: Bus Stop

Description: A table to describe all the bus stops in DCBTS.

Attributes:

StopID – A unique identifier to identify each stop. (Primary Key)StopName – The name of the stop.

Location – The location of the stop.

Entity: Notification

Description: A table to describe all the notifications that address festivalsand other holidays.

Attributes:

NotificationID – A unique identifier to identify each notification. (PrimaryKey)

HolidayID – Identifier of the holiday to which the notification is associated. (Foreign Key)

ReservationID– Identifier of the reservation that will trigger a notification. (Foreign Key)

Message – Message content of the notification.

DateAndTime – Date and Time of when the notification will be displayed.

UserID – The identifier of the user who would see the notification. (ForeignKey)

AdminID – The identifier of the admin who would create the notification. (Foreign Key)

Entity: Holidays

Description: A table to describe the holidays during which the buses willnot be available.

Attributes:

HolidayID – A unique identifier to identify each holiday. (Primary Key)

HolidayDate – The date on which the holiday falls.

Description – Description of the holiday.

NotificationID – Identifier of the notification that will display the about this holiday. (Foreign Key)

- **Multivalued Attributes:**
  1. In the Ticket Type table, Price and ValidityPeriod can have multiple attributes.
  2. In the Route Stop Sequence table, the NumberofStops attribute is multi-valued as it indicates the count of stops on a route.

3. In the Reservation table, the NumberOfReservations attribute is multi-valued.

- **Composite Attributes:**
  1. In the User and Employee table, we have User's name and Employee's name which will be a combination of FirstName and LastName.

- **Derived Attributes:**
  1. In the Payment table, the Amount attribute can be derived from the Price in the Ticket Type.

- **Weak entity:**
  1. Notification: The "Notification" entity is a weak entity because itrelies on either "Admin" or "User" for its existence.

- **Strong entity:**
  1. Bus, Bus Route, Ticket Type, User, Bus Stop, Schedule, Holidays, Route stop sequence, Payment, Reservation, Employee, and Department are strong entities that do not depend on any other entitiesfor their existence or identity.

Participations:

Total Participation:

1. Each payment must be associated with a user, indicating total participation.
2. Each department should be associated with Employee, indicating total participation.
3. Each route stop sequence should be associated with bus stop, indicating total participation.
4. Each bus can be associated with many routes in different schedules same vice versa, which indicates Bus, Route, Schedule a total participation.

Partial Participation:

1. Users may or may not have associated records in other tables.
2. Not all administrators need to have associated employee records.
3. Not all holidays may have associated notification records.
4. Bus may or may not be associated with reservation.
5. Not all notifications need to be associated with User and Admin.
6. Not all reservations may be associated with notification records.

Cardinality Ratios:

1-N Cardinality Ratio:

- User: One user can make multiple payments (1-N cardinality).
- Notification: One admin or user can have multiple notifications (1-N cardinality).
- Payment: One user can make multiple payments (1-N cardinality).
- Reservation: One user can makemultiple reservations (1-Ncardinality).
- Employee: One department can have multiple employees (1-Ncardinality).
- BusStop: Each bus stop can be involved with multiple route stopsequence (1-N cardinality).

1-1 Cardinality Ratio:

- Reservation: Each reservation is associated with one notification (1-1 cardinality).
- Holidays: Each holiday is associated with one notification (1-1cardinality).

M-N Cardinality Ratio:

- Route stop sequence: Many routes can have many stops.
- Bus: Multiple buses can be associated with multiple routes.
- Payment: multiple payments lead to multiple reservations.
- Schedule: Different schedules linked to available buses.

The entity-relationship conceptual model of a database can be represented graphically, using a diagram. These diagrams are simple and intuitive, and their basic components are:

- Rectangles - specifying entity types
- Ellipses - specifying attributes
- Romboids - specifying relationship types
- Lines - connections between entities and attributes, or entities and relationship types.

In the picture, you can see a more detailed overview of the notation:

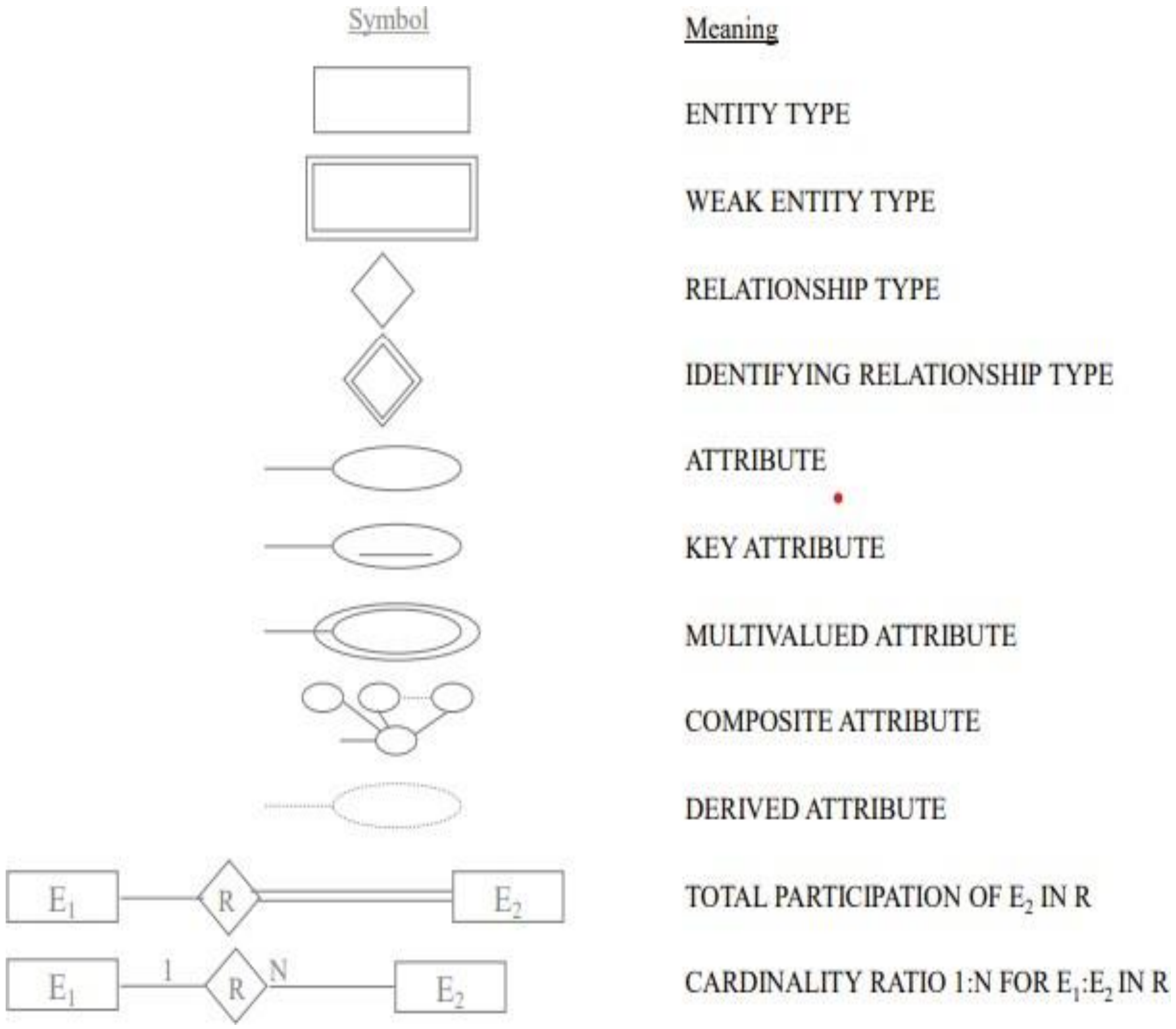


Figure 6. 1 Relationship of Entity Relationship Model

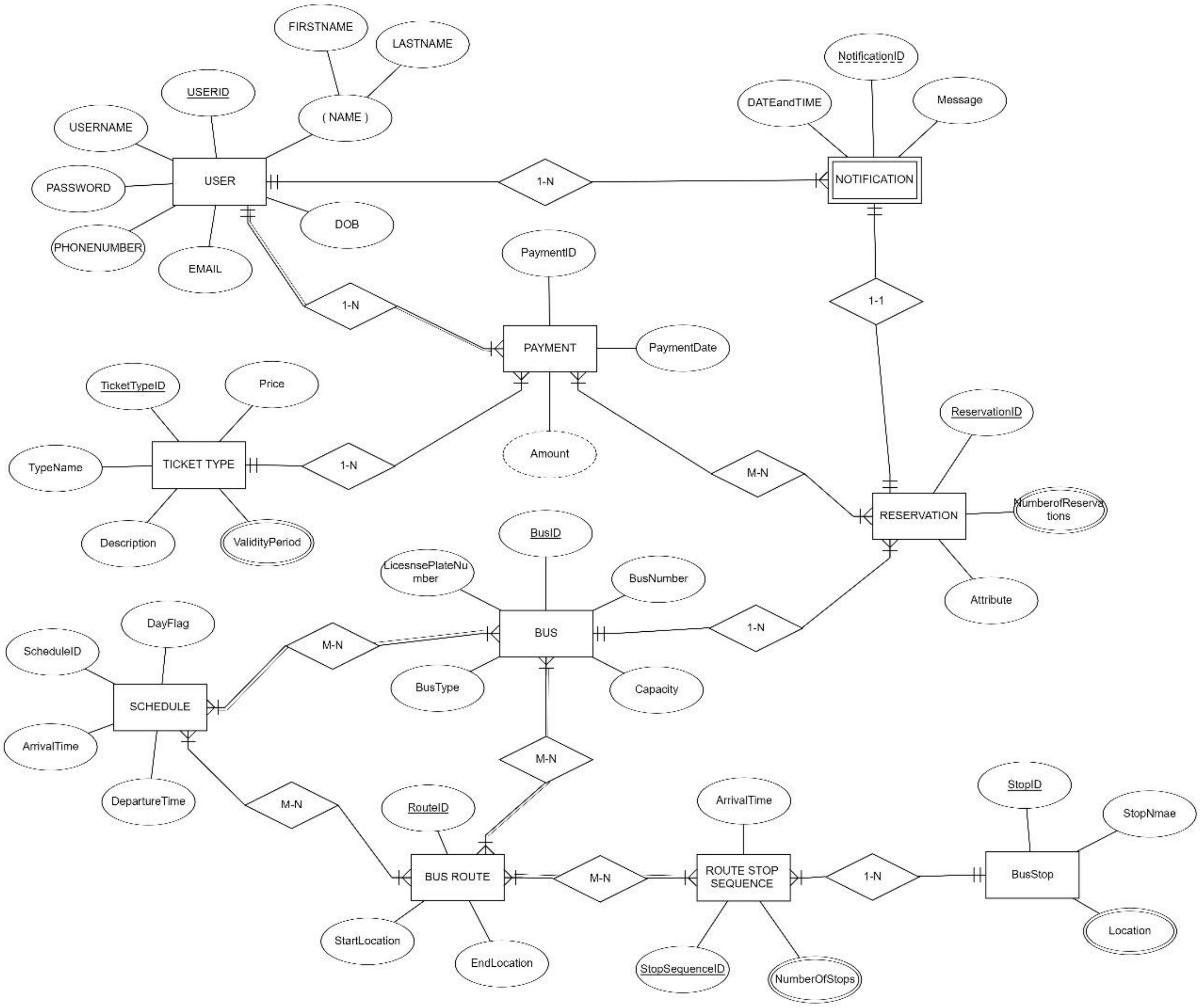


Figure 6. 2 External ER USER POV

As an external ER user, I can see that the system is designed to help me manage my bus reservations. I can use the system to view available bus routes and schedules, make reservations, and pay for my tickets. I can also use the system to track my reservations and receive notifications about changes to my schedule.

The system is easy to use and navigate. I can quickly find the information I need and make reservations with just a few clicks. I appreciate that the system provides me with real-time information about bus availability and schedules. This helps me to plan my trips and make sure that I am on time for my reservations.

I am also impressed with the system's security features. I can feel confident that my personal information is safe and secure when I make a reservation. Overall, I am very satisfied with the external ER user experience of this system.

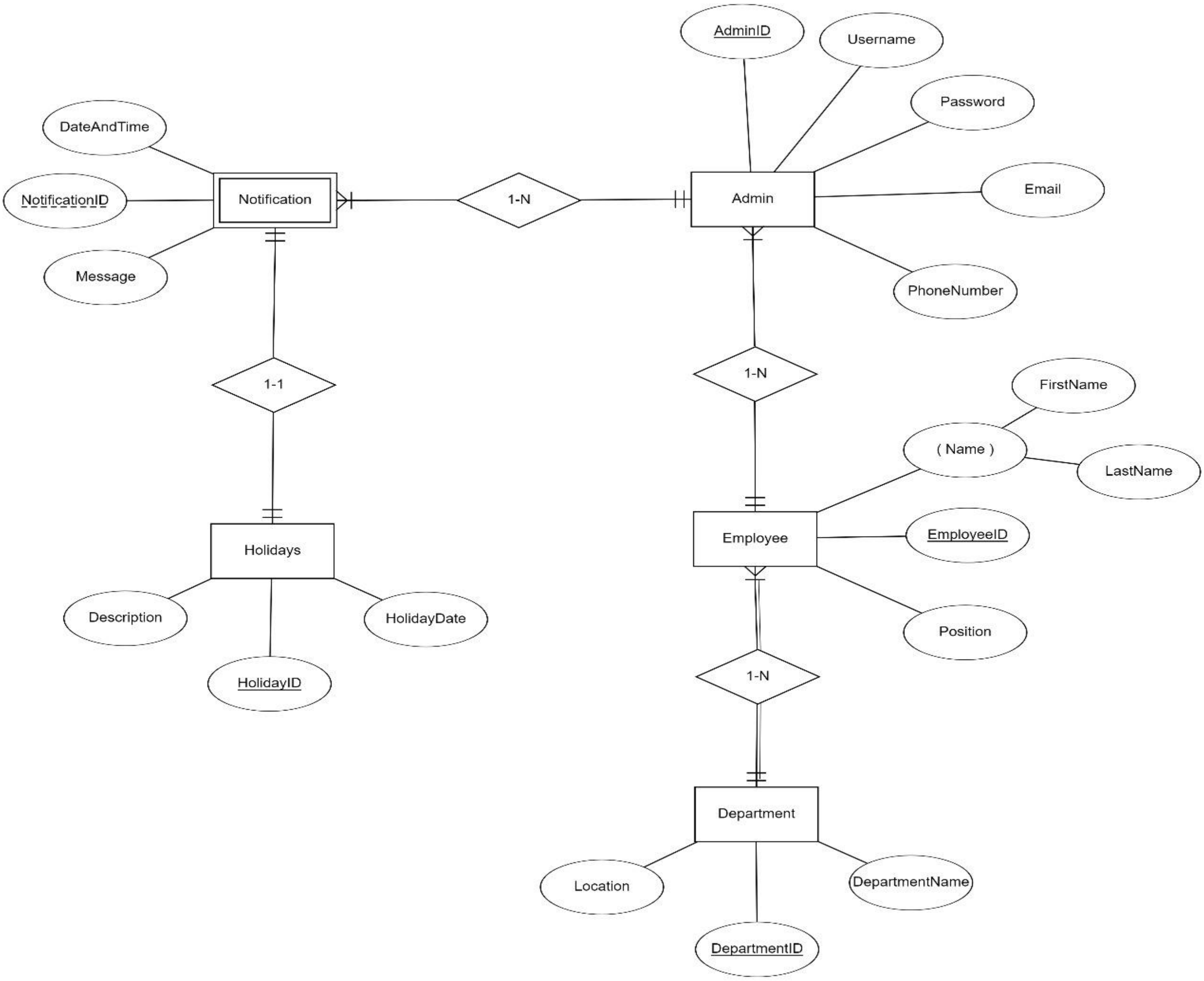


Figure 6. 3 External ER ADMIN POV

As an external ER admin, I am responsible for managing the system that allows employees to communicate with each other. This system is critical to our organization, as it allows employees to stay connected and collaborate on projects.

The system is easy to use and navigate. Employees can quickly find the information they need and communicate with each other with just a few clicks. I appreciate that the system provides me with real-time information about employee activity. This helps me to identify and address any potential issues early on.

I am also impressed with the system's security features. I can feel confident that our employees' communications are safe and secure. Overall, I am very satisfied with the external ER admin experience of this system.

The system is well-designed and meets the needs of our organization. I am confident that it will continue to be a valuable tool for our employees in the future.

ENTITY RELATIONSHIP DIAGRAM

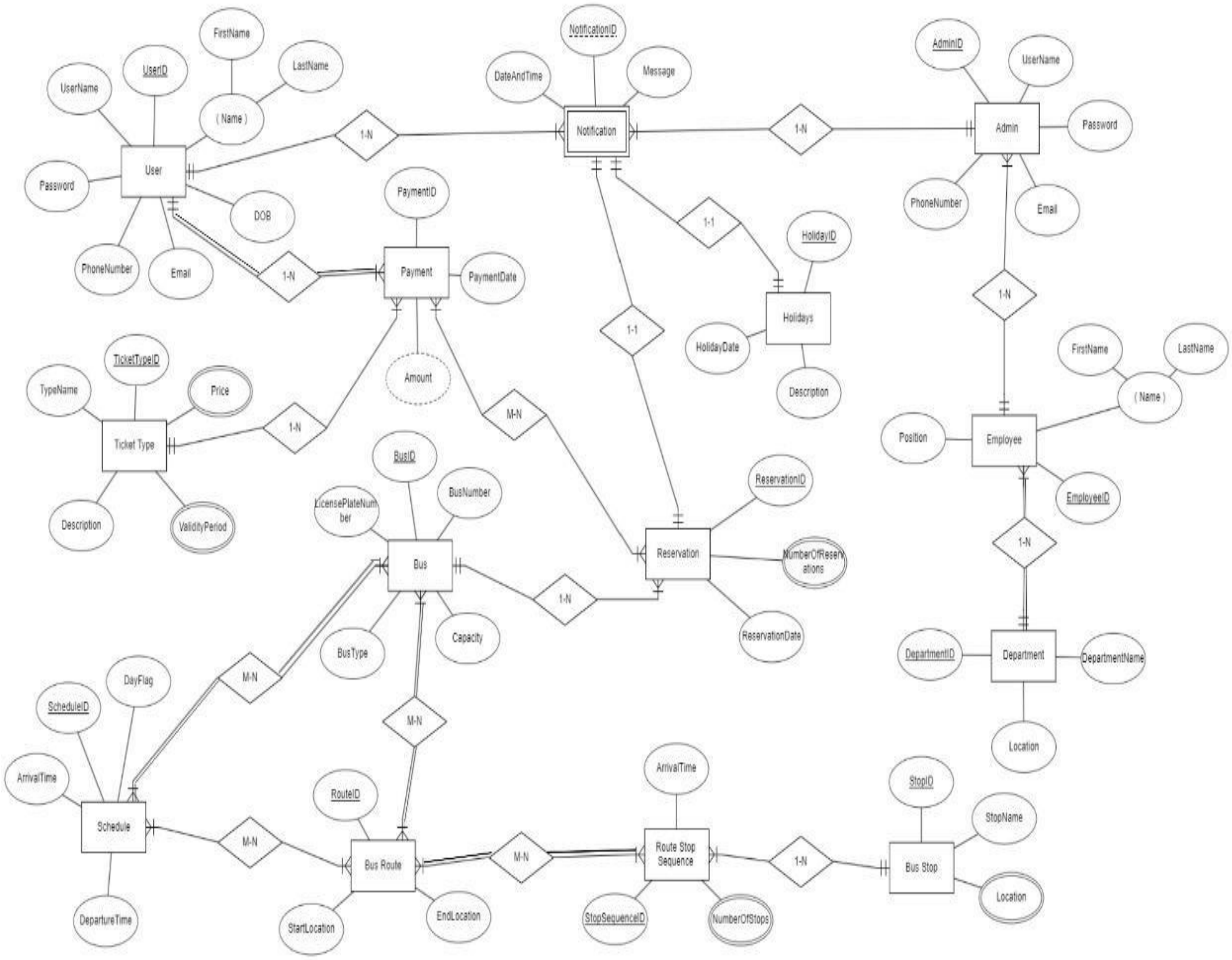


Figure 6. 4 Entity Relationship

7.ENHANCED ENTITY RELATIONSHIP MODEL(EER MODEL)

EER Diagram, also abbreviated as Enhanced Entity-relationship diagram, helps us create and maintain detailed databases through high-level models and tools. In addition, they are developed on the basic ER diagrams and are its extended version.

EER Diagrams basically help in creating and maintaining excellent databases with the help of smart and efficient techniques. It is a visual representation of the plan or the overall outlook of the database you intend to create.

We have used MySQL Workbench to create the EER diagram. Enhanced Entity-Relationship (EER) diagrams are an essential part of the modeling interface in MySQL Workbench. EER diagrams provide a visual representation of the relationships among the tables in our model.

When the application became complex, the traditional ER model was not enough to draw a sophisticated diagram. Therefore, the ER model was developed further. It is known as the Enhanced ER diagram. There are threeconcepts added to the existing ER model in the Enhanced ER diagram (EER). Those are generalization, specialization, and aggregation. In generalization, the lower-level entities can be combined to produce a higher- level entity. Specialization is the opposite of generalization. In specialization, the high-level entities can be divided into lower-level entities.Aggregation is a process when the relation between two entities is treated asa single entity.

Additionally, it includes the concepts of a subclass and superclass (Is-a). Furthermore, it introduces the concept of a union type or category, which represents a collection of objects that is the union of objects of different entity types. The EER model also includes EER diagrams which are conceptual models that accurately represent the requirements of complex databases.

7.1 IMPLEMENTATION OF EER

This Enhanced Entity Relationship (EER) diagram offers a comprehensive model for a complex system comprising essential entities, including payment, employee, admin, ticket type, time, date, last name, department, name, and Sunday Bus schedules. Each entity plays a distinctive role within the database structure. Payment, for instance, is intricately connected to a specific ticket type, employee, and date, ensuring precise payment records. Meanwhile, employees and admins are associated with departments and identified by their First name and Last name, forming the backbone of personnel management.

Ticket types are uniquely defined by their names and prices, preventing any duplications, while time and date entities offer precise temporal and date- based representations. Names act as versatile identifiers across various domains, connecting entities within the system. Additionally, Sunday schedules are distinctly linked to a department, date, and time for efficient planning.

The relationships between these entities are systematically outlined, ensuringdata integrity and retrieval efficiency. For example, strict associations like payments being tied to one ticket type, employee, and date eliminate any chances of duplicate payments. This design not only safeguards data but alsostreamlines data retrieval, making it easier to extract meaningful informationfrom the database.

In conclusion, this well-designed EER diagram offers an efficient model forthe system's organization. It ensures data integrity, enhances data retrieval performance, and provides clarity, making it a valuable tool for managing and organizing complex data structures within the described system.

ENHANCED ENTITY RELATIONSHIP DIAGRAM

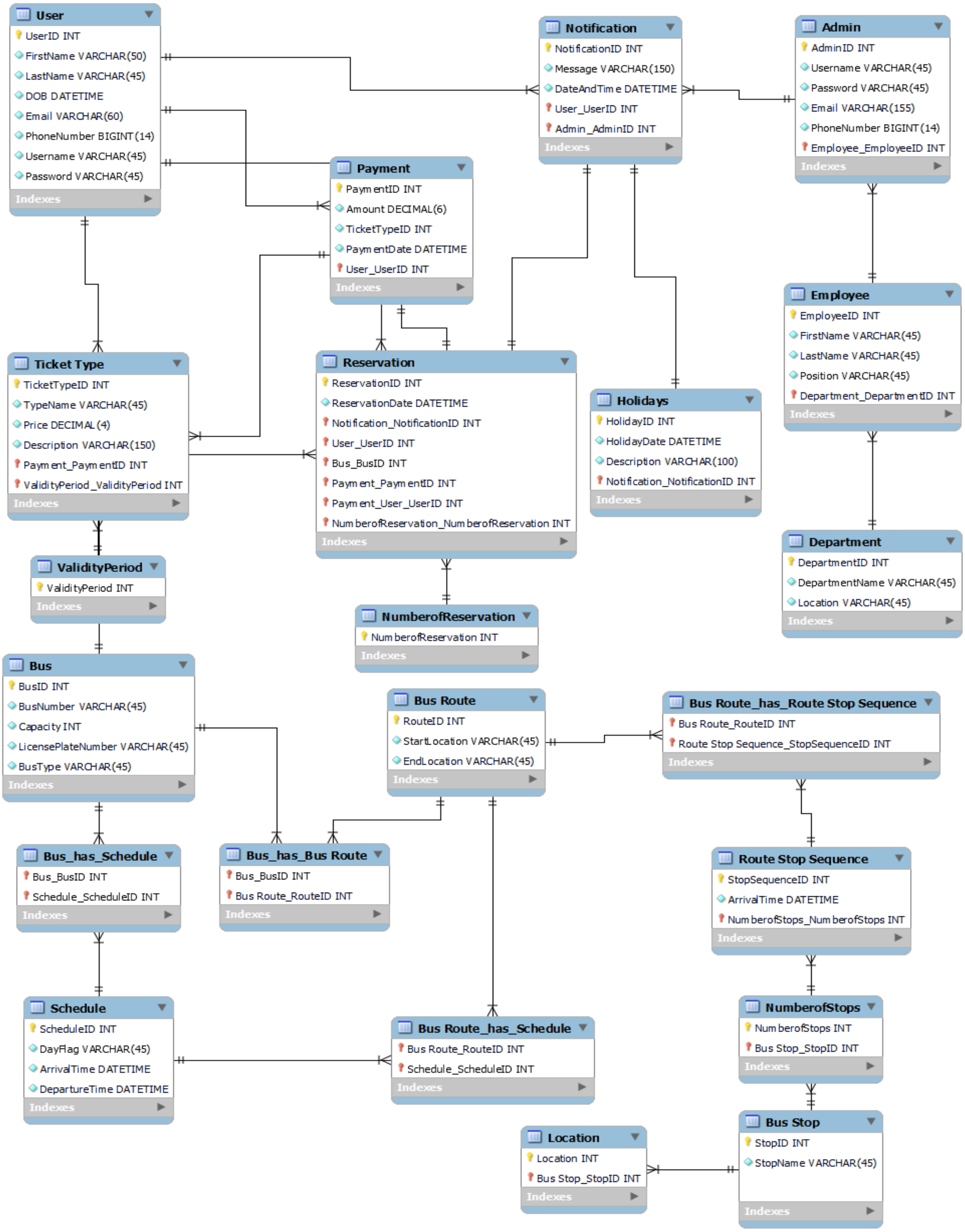


Figure 7. 1 Enhanced Entity Relationship

8. DATABASE DEVELOPMENT

Database development plays a crucial role in managing and leveraging data efficiently, securely, and at scale. It is used to create various applications and is essential for businesses seeking to show the importance of data for decision-making and innovation.

The below schema has been created from the Enhanced Entity Diagram, that involves all the tables, meets all the primary and foreign key constraints.

8.1 DESCRIPTION:

Table Name	Description
User	**Usage:** User table defines a user in the DCBTS. **Data attributes:** 1. UserID INT 2. FirstName VARCHAR(50) 3. LastName VARCHAR(45) 4. DOB DATETIME 5. Email VARCHAR(60) 6. PhoneNumber BIGINT(14) 7. Username VARCHAR(45) 8. Password VARCHAR(45) **Constraints:** 1. PRIMARY KEY – UserID **Relationships:** 1. A User can make many Payments. 2. A User can receive many Notifications.
Bus	**Usage:** Bus table defines a bus in the DCBTS. **Data attributes:** 1. BusID INT 2. BusNumber VARCHAR(45) 3. Capacity INT 4. LicensePlateNumber VARCHAR(45) 5. BusType VARCHAR(45) **Constraints:** 1. PRIMARY KEY- BusID **Relationships:** 1. A User can make many Payments. 2. A User can receive many Notifications.

Department	**Usage:** Department table defines the departments in the DCBTS. **Data Attributes:** 1. DepartmentID INT 2. DepartmentName VARCHAR(45) 3. Location VARCHAR(45) **Contraints:** 1. PRIMARY KEY- DepartmentID **Relationships:** 1. A Department has many Employees.
Employee	**Usage:** Employee table defines an employee in the DCBTS. **Data Attributes:** 1. EmployeeID INT 2. FirstName VARCHAR(45) 3. LastName VARCHAR(45) 4. Position VARCHAR(45) 5. Department_DepartmentID INT **Contraints:** 1. PRIMARY KEY-EmployeeID, Department_DepartmentID 2. FOREIGN KEY-Department(DepartmentID) **Relationships:** 1. An Employee works in one Department. 2. An Employee can be linked to one Admin account.
Admin	**Usage:** Admin table defines an admin in the DCBTS. **Data Attributes:** 1. AdminID INT 2. Username VARCHAR(45) 3. Password VARCHAR(45) 4. Email VARCHAR(155) 5. PhoneNumber BIGINT(14) 6. Employee_EmployeeID INT **Constraints:** 1. PRIMARY KEY- AdminID, Employee_EmployeeID 2. FOREIGN KEY - Employee (EmployeeID) **Relationships:** 1. An Admin is linked to one Employee.

	2. An Admin can send many Notifications.
Payment	**Usage:** Payment table defines a payment made in the DCBTS. **Data Attributes:** 1. PaymentID INT 2. Amount DECIMAL(6) 3. PaymentDate DATETIME 4. User_UserID` INT 5. Ticket Type_TicketTypeID INT **Constraints:** 1. PRIMARY KEY-PaymentID, User_UserID, TicketType_TicketTypeID 2. FOREIGN KEY – User(UserID), TicketType(TicketTypeID) **Relationships:** 1. A Payment is made by one User. 2. A Payment is for one TicketType. 3. A Payment can be linked to many Reservations.
Schedule	**Usage:** Schedule table defines a schedule in the DCBTS. **Data Attributes:** 1. ScheduleID INT NOT NULL 2. DayFlag VARCHAR(45) 3. ArrivalTime DATETIME 4. DepartureTime DATETIME **Constraints:** 1. PRIMARY KEY- ScheduleID **Relationships:** 1. A Schedule can be assigned to many Buses. 2. A Schedule can be assigned to many Routes.
BusRoute	**Usage:** BusRoute defines a bus route in the DCBTS. **Data Attributes:** 1. RouteID INT 2. StartLocation VARCHAR(45) 3. EndLocation VARCHAR(45) **Constraints:** 1. PRIMARY KEY-RouteID **Relationships:** 1. A Route has many RouteStopSequences. 2. A Route can be assigned many Schedules.

	3. A Route can have many Buses assigned to it.
BusStop	**Usage:** BusStop table defines a bus stop in the DCBTS. **Data Attributes:** 1. StopID INT 2. StopName VARCHAR(45) 3. Location VARCHAR(45) **Constraints:** 1. PRIMARY KEY-StopID **Relationships:** 1. One (BusStop) to Many (RouteStopSequences). 2. One bus stop can be assigned to many route stop sequences.
RouteStopSequence	**Usage:** Route Stop Sequence table defines the sequence of the stops in a route. **Data Attributes:** 1. StopSequenceID INT 2. NumberofStops INT 3. ArrivalTime DATETIME 4. Bus Stop_StopID INT **Constraints:** 1. PRIMARY KEY-StopSequenceID, Bus Stop_StopID 2. FOREIGN KEY- BusStop(StopID) **Relationships:** 1. Many (RouteStopSequences) to One (BusRoute). 2. One bus route has many route stop sequences.
TicketType	**Usage:** TicketType table defines the types of tickets in DCBTS. **Data Attributes:** 1. TicketTypeID INT 2. TypeName VARCHAR(45) 3. Price DECIMAL(4) 4. ValidityPeriod INT 5. Description VARCHAR(150) **Constraints:** 1. PRIMARY KEY-TicketTypeID **Relationships:**

	1. One (TicketType) to Many (Payments). 2. One ticket type can be used for many payments.
Notification	**Usage:** Notification table defines a notification of important events in the DCBTS. **Data Attributes:** 1. NotificationID INT 2. Message VARCHAR(150) 3. DateAndTime DATETIME 4. User_UserID INT 5. Admin_AdminID INT **Constraints:** 1. PRIMARY KEY-NotificationID, User_UserID, Admin_AdminID 2. FOREIGN KEY- User(UserID), Admin(AdminID) **Relationships:** 1. A Notification is sent by one Admin. 2. A Notification is sent to one User. 3. A Notification can be linked to many Holidays. 4. A Notification can be linked to many Reservations.
Holidays	**Usage:** Holidays table defines the holidays in DCBTS. **Data Attributes:** 1. HolidayID INT 2. HolidayDate DATETIME 3. Description VARCHAR(100) 4. Notification_NotificationID INT **Constraints:** 1. PRIMARY KEY-HolidayID, Notification_NotificationID 2. FOREIGN KEY- Notification(NotificationID) **Relationships:** 1. Many (Holidays) to One (Notification). 2. One notification can be linked to many holidays.
Reservation	**Usage:** Reservation table defines a reservation made by the user in DCBTS.

	Data Attributes: 1. ReservationID INT 2. ReservationDate DATETIME 3. NumberOfReservations INT 4. Notification_NotificationID INT 5. Bus_BusID INT **Constraints:** 1. PRIMARY KEY-ReservationID, Notification_NotificationID, Bus_BusID 2. FOREIGN KEY-Notification(NotificationID), Bus(BusID) **Relationships:** 1. Many (Reservations) to One (Notification). 2. One notification can be linked to many reservations.
BusRoute_has_RouteStopSequence	**Usage:** Links one BusRoute to one RouteStopSequence. **Data Attributes:** 1. Bus Route_RouteID INT 2. RouteStopSequence_StopSequenceID INT **Constraints:** 1. PRIMARY KEY-BusRoute_RouteID, RouteStopSequence_StopSequenceID 2. FOREIGN KEY-BusRoute(RouteID),RouteStopSequence(StopSequenceID) **Realtionships:** 1. One bus route can be linked to many route stop sequences. 2. One route stop sequence can be linked to many bus routes.
Payment_has_Reservation	**Usage:** Links one Payment to one Reservation. **Data Attributes:** 1. Payment_PaymentID INT 2. Payment_User_UserID INT 3. Payment_Ticket Type_TicketTypeID INT 4. Reservation_ReservationID INT 5. Reservation_Notification_NotificationID INT 6. Reservation_Bus_BusID INT **Constraints:** 1. PRIMARY KEY-Payment_PaymentID,

	Payment_User_UserID, Payment_Ticket Type_TicketTypeID, Reservation_ReservationID, Reservation_Notification_NotificationID, Reservation_Bus_BusID 2. FOREIGN KEY- Payment(PaymentID, User_UserID,Ticket Type_TicketTypeID), Reservation(ReservationID,Notification_NotificationID,Bus_BusID) **Realtionships:** 1. One (Payment) to One (Reservation). 2. Links one payment to one reservation.
Bus_has_Schedule	**Usage:** Links one Bus to one Schedule. **Data Attributes:** 1. Bus_BusID INT 2. Schedule_ScheduleID INT **Constraints:** 1. PRIMARY KEY-Bus_BusID, Schedule_ScheduleID 2. FOREIGN KEY- Bus(BusID), Schedule(ScheduleID) **Realtionships:** 1. One bus can be assigned many schedules. 2. One schedule can be assigned to many buses.
Bus_has_BusRoute	**Usage:** Links one Bus to one BusRoute. **Data Attributes:** 1. Bus_BusID INT 2. Bus Route_RouteID INT **Constraints:** 1. PRIMARY KEY-Bus_BusID, Bus Route_RouteID 2. FOREIGN KEY -Bus(BusID), BusRoute(RouteID) **Realtionships:** 1. One bus can be assigned many routes 2. One route can have many buses assigned
BusRoute_has_Schedule	**Usage:** Links one BusRoute to one Schedule. **Data Attributes:** 1. Bus Route_RouteID INT

	2. Schedule_ScheduleID INT **Constraints:** 1. PRIMARY KEY-Bus Route_RouteID, Schedule_ScheduleID 2. FOREIGN KEY- Bus Route(RouteID), Schedule(ScheduleID) **Realtionships:** 1. One route can have many schedules. 2. One schedule can be assigned to many routes.

8.2 CREATE STATEMENTS:

1. Create Dutchess_county_bus_transportation_DBMS_project Database:

```
CREATE DATABASE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`;
USE `Dutchess_county_bus_transportation_DBMS_project` ;
```

2. Create User Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`User` (
  `UserID` INT NOT NULL AUTO_INCREMENT,
  `FirstName` VARCHAR(50) NOT NULL,
  `LastName` VARCHAR(45) NOT NULL,
  `DOB` DATETIME NOT NULL,
  `Email` VARCHAR(60) NOT NULL,
  `PhoneNumber` BIGINT(14) NOT NULL,
  `Username` VARCHAR(45) NOT NULL,
  `Password` VARCHAR(45) NOT NULL,
  PRIMARY KEY (`UserID`),
  UNIQUE INDEX `Username_UNIQUE` (`Username` ASC) VISIBLE,
  UNIQUE INDEX `UserID_UNIQUE` (`UserID` ASC) VISIBLE)
ENGINE = InnoDB;
```

3. Create Bus Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Bus` (
  `BusID` INT NOT NULL AUTO_INCREMENT,
  `BusNumber` VARCHAR(45) NOT NULL,
  `Capacity` INT NOT NULL,
  `LicensePlateNumber` VARCHAR(45) NOT NULL,
  `BusType` VARCHAR(45) NOT NULL,
  PRIMARY KEY (`BusID`),
  UNIQUE INDEX `BusID_UNIQUE` (`BusID` ASC) VISIBLE,
  UNIQUE INDEX `BusNumber_UNIQUE` (`BusNumber` ASC) VISIBLE,
  UNIQUE INDEX `LicensePlateNumber_UNIQUE` (`LicensePlateNumber` ASC)
VISIBLE)
ENGINE = InnoDB;
```

4. Create BusRoute Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Bus Route` (
  `RouteID` INT NOT NULL AUTO_INCREMENT,
  `StartLocation` VARCHAR(45) NOT NULL,
  `EndLocation` VARCHAR(45) NOT NULL,
  PRIMARY KEY (`RouteID`))
ENGINE = InnoDB;
```

5. Create TicketType Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Ticket Type` (
  `TicketTypeID` INT NOT NULL,
  `TypeName` VARCHAR(45) NOT NULL,
  `Price` DECIMAL(4) NOT NULL,
  `ValidityPeriod` INT NULL,
  `Description` VARCHAR(150) NOT NULL,
  PRIMARY KEY (`TicketTypeID`),
  UNIQUE INDEX `TicketTypeID_UNIQUE` (`TicketTypeID` ASC) VISIBLE,
  UNIQUE INDEX `TypeName_UNIQUE` (`TypeName` ASC) VISIBLE)
ENGINE = InnoDB;
```

6. Create Department Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Department` (
  `DepartmentID` INT NOT NULL AUTO_INCREMENT,
  `DepartmentName` VARCHAR(45) NOT NULL,
  `Location` VARCHAR(45) NOT NULL,
  PRIMARY KEY (`DepartmentID`),
  UNIQUE INDEX `DepartmentID_UNIQUE` (`DepartmentID` ASC) VISIBLE)
ENGINE = InnoDB;
```

7. Create Employee Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Employee` (
  `EmployeeID` INT NOT NULL AUTO_INCREMENT,
  `FirstName` VARCHAR(45) NOT NULL,
  `LastName` VARCHAR(45) NOT NULL,
  `Position` VARCHAR(45) NOT NULL,
  `Department_DepartmentID` INT NOT NULL,
  PRIMARY KEY (`EmployeeID`, `Department_DepartmentID`),
  UNIQUE INDEX `EmployeeID_UNIQUE` (`EmployeeID` ASC) VISIBLE,
  INDEX `fk_Employee_Department1_idx` (`Department_DepartmentID` ASC) VISIBLE,
  CONSTRAINT `fk_Employee_Department1`
    FOREIGN KEY (`Department_DepartmentID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Department`
(`DepartmentID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

8. Create Admin Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Admin` (
  `AdminID` INT NOT NULL AUTO_INCREMENT,
  `Username` VARCHAR(45) NOT NULL,
  `Password` VARCHAR(45) NOT NULL,
  `Email` VARCHAR(155) NOT NULL,
  `PhoneNumber` BIGINT(14) NOT NULL,
  `Employee_EmployeeID` INT NOT NULL,
  PRIMARY KEY (`AdminID`, `Employee_EmployeeID`),
  UNIQUE INDEX `AdminID_UNIQUE` (`AdminID` ASC) VISIBLE,
  UNIQUE INDEX `Email_UNIQUE` (`Email` ASC) VISIBLE,
  UNIQUE INDEX `PhoneNumber_UNIQUE` (`PhoneNumber` ASC) VISIBLE,
  INDEX `fk_Admin_Employee1_idx` (`Employee_EmployeeID` ASC) VISIBLE,
  CONSTRAINT `fk_Admin_Employee1`
    FOREIGN KEY (`Employee_EmployeeID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Employee`
(`EmployeeID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

9. Create BusStop Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Bus Stop` (
  `StopID` INT NOT NULL AUTO_INCREMENT,
  `StopName` VARCHAR(45) NOT NULL,
  `Location` VARCHAR(45) NOT NULL,
  PRIMARY KEY (`StopID`),
  UNIQUE INDEX `StopID_UNIQUE` (`StopID` ASC) VISIBLE)
ENGINE = InnoDB;
```

10. Create Notification Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Notification` (
  `NotificationID` INT NOT NULL AUTO_INCREMENT,
  `Message` VARCHAR(150) NOT NULL,
  `DateAndTime` DATETIME NOT NULL,
  `User_UserID` INT NOT NULL,
  `Admin_AdminID` INT NOT NULL,
  PRIMARY KEY (`NotificationID`, `User_UserID`, `Admin_AdminID`),
  UNIQUE INDEX `NotificationID_UNIQUE` (`NotificationID` ASC) VISIBLE,
  INDEX `fk_Notification_User1_idx` (`User_UserID` ASC) VISIBLE,
  INDEX `fk_Notification_Admin1_idx` (`Admin_AdminID` ASC) VISIBLE,
  CONSTRAINT `fk_Notification_User1`
    FOREIGN KEY (`User_UserID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`User` (`UserID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Notification_Admin1`
    FOREIGN KEY (`Admin_AdminID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Admin`
(`AdminID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

11. Create Holidays Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Holidays` (
  `HolidayID` INT NOT NULL AUTO_INCREMENT,
  `HolidayDate` DATETIME NOT NULL,
  `Description` VARCHAR(100) NOT NULL,
  `Notification_NotificationID` INT NOT NULL,
  PRIMARY KEY (`HolidayID`, `Notification_NotificationID`),
  INDEX `fk_Holidays_Notification1_idx` (`Notification_NotificationID` ASC) VISIBLE,
  CONSTRAINT `fk_Holidays_Notification1`
    FOREIGN KEY (`Notification_NotificationID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Notification`
(`NotificationID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

12. Create RouteStopSequence Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Route Stop Sequence` (
  `StopSequenceID` INT NOT NULL AUTO_INCREMENT,
  `NumberofStops` INT NOT NULL,
  `ArrivalTime` DATETIME NOT NULL,
  `Bus Stop_StopID` INT NOT NULL,
  PRIMARY KEY (`StopSequenceID`, `Bus Stop_StopID`),
  UNIQUE INDEX `StopSequenceID_UNIQUE` (`StopSequenceID` ASC) VISIBLE,
  INDEX `fk_Route Stop Sequence_Bus Stop1_idx` (`Bus Stop_StopID` ASC) VISIBLE,
  CONSTRAINT `fk_Route Stop Sequence_Bus Stop1`
    FOREIGN KEY (`Bus Stop_StopID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Bus Stop`
(`StopID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

13. Create Payment Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Payment` (
  `PaymentID` INT NOT NULL,
  `Amount` DECIMAL(6) NOT NULL,
  `PaymentDate` DATETIME NOT NULL,
  `User_UserID` INT NOT NULL,
  `Ticket Type_TicketTypeID` INT NOT NULL,
  PRIMARY KEY (`PaymentID`, `User_UserID`, `Ticket Type_TicketTypeID`),
  INDEX `fk_Payment_User1_idx` (`User_UserID` ASC) VISIBLE,
  INDEX `fk_Payment_Ticket Type1_idx` (`Ticket Type_TicketTypeID` ASC) VISIBLE,
  CONSTRAINT `fk_Payment_User1`
    FOREIGN KEY (`User_UserID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`User` (`UserID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Payment_Ticket Type1`
    FOREIGN KEY (`Ticket Type_TicketTypeID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Ticket Type`
(`TicketTypeID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

14. Create Reservation Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Reservation` (
  `ReservationID` INT NOT NULL AUTO_INCREMENT,
  `ReservationDate` DATETIME NOT NULL,
  `NumberOfReservations` INT NOT NULL,
  `Notification_NotificationID` INT NOT NULL,
  `Bus_BusID` INT NOT NULL,
  PRIMARY KEY (`ReservationID`, `Notification_NotificationID`, `Bus_BusID`),
  INDEX `fk_Reservation_Notification1_idx` (`Notification_NotificationID` ASC) VISIBLE,
  INDEX `fk_Reservation_Bus1_idx` (`Bus_BusID` ASC) VISIBLE,
  CONSTRAINT `fk_Reservation_Notification1`
    FOREIGN KEY (`Notification_NotificationID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Notification`
(`NotificationID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Reservation_Bus1`
    FOREIGN KEY (`Bus_BusID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Bus` (`BusID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

15. Create Bus_has_Bus Route Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Bus_has_Bus Route` (
  `Bus_BusID` INT NOT NULL,
  `Bus Route_RouteID` INT NOT NULL,
  PRIMARY KEY (`Bus_BusID`, `Bus Route_RouteID`),
  INDEX `fk_Bus_has_Bus Route_Bus Route1_idx` (`Bus Route_RouteID` ASC) VISIBLE,
  INDEX `fk_Bus_has_Bus Route_Bus1_idx` (`Bus_BusID` ASC) VISIBLE,
  CONSTRAINT `fk_Bus_has_Bus Route_Bus1`
    FOREIGN KEY (`Bus_BusID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Bus` (`BusID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Bus_has_Bus Route_Bus Route1`
    FOREIGN KEY (`Bus Route_RouteID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Bus Route`
(`RouteID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

16. Create Bus Route_has_RouteStopSequence Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Bus Route_has_Route Stop
Sequence` (
  `Bus Route_RouteID` INT NOT NULL,
  `Route Stop Sequence_StopSequenceID` INT NOT NULL,
  PRIMARY KEY (`Bus Route_RouteID`, `Route Stop Sequence_StopSequenceID`),
  INDEX `fk_Bus Route_has_Route Stop Sequence_Route Stop Sequence1_idx` (`Route Stop
Sequence_StopSequenceID` ASC) VISIBLE,
  INDEX `fk_Bus Route_has_Route Stop Sequence_Bus Route1_idx` (`Bus Route_RouteID`
ASC) VISIBLE,
  CONSTRAINT `fk_Bus Route_has_Route Stop Sequence_Bus Route1`
    FOREIGN KEY (`Bus Route_RouteID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Bus Route`
(`RouteID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Bus Route_has_Route Stop Sequence_Route Stop Sequence1`
    FOREIGN KEY (`Route Stop Sequence_StopSequenceID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Route Stop
Sequence` (`StopSequenceID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

17. Create Schedule Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Schedule` (
  `ScheduleID` INT NOT NULL AUTO_INCREMENT,
  `DayFlag` VARCHAR(45) NOT NULL,
  `ArrivalTime` DATETIME NOT NULL,
  `DepartureTime` DATETIME NOT NULL,
  PRIMARY KEY (`ScheduleID`),
  UNIQUE INDEX `ScheduleID_UNIQUE` (`ScheduleID` ASC) VISIBLE)
ENGINE = InnoDB;
```

18. Create Bus_has_Schedule Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Bus_has_Schedule` (
  `Bus_BusID` INT NOT NULL,
  `Schedule_ScheduleID` INT NOT NULL,
  PRIMARY KEY (`Bus_BusID`, `Schedule_ScheduleID`),
  INDEX `fk_Bus_has_Schedule_Schedule1_idx` (`Schedule_ScheduleID` ASC) VISIBLE,
  INDEX `fk_Bus_has_Schedule_Bus1_idx` (`Bus_BusID` ASC) VISIBLE,
  CONSTRAINT `fk_Bus_has_Schedule_Bus1`
    FOREIGN KEY (`Bus_BusID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Bus` (`BusID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Bus_has_Schedule_Schedule1`
    FOREIGN KEY (`Schedule_ScheduleID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Schedule`
(`ScheduleID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

19. Create Bus Route_has_Schedule Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Bus Route_has_Schedule` (
  `Bus Route_RouteID` INT NOT NULL,
  `Schedule_ScheduleID` INT NOT NULL,
  PRIMARY KEY (`Bus Route_RouteID`, `Schedule_ScheduleID`),
  INDEX `fk_Bus Route_has_Schedule_Schedule1_idx` (`Schedule_ScheduleID` ASC)
VISIBLE,
  INDEX `fk_Bus Route_has_Schedule_Bus Route1_idx` (`Bus Route_RouteID` ASC)
VISIBLE,
  CONSTRAINT `fk_Bus Route_has_Schedule_Bus Route1`
    FOREIGN KEY (`Bus Route_RouteID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Bus Route`
(`RouteID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Bus Route_has_Schedule_Schedule1`
    FOREIGN KEY (`Schedule_ScheduleID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Schedule`
(`ScheduleID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

20. Create Payment_has_Reservation Table:

```
CREATE TABLE IF NOT EXISTS
`Dutchess_county_bus_transportation_DBMS_project`.`Payment_has_Reservation` (
  `Payment_PaymentID` INT NOT NULL,
  `Payment_User_UserID` INT NOT NULL,
  `Payment_Ticket Type_TicketTypeID` INT NOT NULL,
  `Reservation_ReservationID` INT NOT NULL,
  `Reservation_Notification_NotificationID` INT NOT NULL,
  `Reservation_Bus_BusID` INT NOT NULL,
  PRIMARY KEY (`Payment_PaymentID`, `Payment_User_UserID`, `Payment_Ticket
Type_TicketTypeID`, `Reservation_ReservationID`,
`Reservation_Notification_NotificationID`, `Reservation_Bus_BusID`),
  INDEX `fk_Payment_has_Reservation_Reservation1_idx` (`Reservation_ReservationID`
ASC, `Reservation_Notification_NotificationID` ASC, `Reservation_Bus_BusID` ASC)
VISIBLE,
  INDEX `fk_Payment_has_Reservation_Payment1_idx` (`Payment_PaymentID` ASC,
`Payment_User_UserID` ASC, `Payment_Ticket Type_TicketTypeID` ASC) VISIBLE,
  CONSTRAINT `fk_Payment_has_Reservation_Payment1`
    FOREIGN KEY (`Payment_PaymentID` , `Payment_User_UserID` , `Payment_Ticket
Type_TicketTypeID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Payment`
(`PaymentID` , `User_UserID` , `Ticket Type_TicketTypeID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `fk_Payment_has_Reservation_Reservation1`
    FOREIGN KEY (`Reservation_ReservationID` ,
`Reservation_Notification_NotificationID` , `Reservation_Bus_BusID`)
    REFERENCES `Dutchess_county_bus_transportation_DBMS_project`.`Reservation`
(`ReservationID` , `Notification_NotificationID` , `Bus_BusID`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION)
ENGINE = InnoDB;
```

9. LOADING DATA AND PERFORMANCE ENHANCEMENTS

9.1 HANDLING FOREIGN KEY CONSTRAINTS:

Case 1:

a) Insert parent Department records first

```
INSERT INTO Department (DepartmentName, Location)
VALUES
  ('Operations', '123 Main St'),
  ('Maintenance', '456 Park Rd');
```

b) Then insert child Employee records

```
INSERT INTO Employee (FirstName, Department_DepartmentID)
VALUES
  ('John', 1),
  ('Jane', 2);
```

c) Disable FK checks

```
SET foreign_key_checks = 0;
```

d) Insert Bus records with invalid Department_ID

```
INSERT INTO Employee (FirstName, Department_DepartmentID) VALUES ('Bob', 3);
```

e) Enable FK checks again

```
SET foreign_key_checks = 1;
```

Description:

- The Department table is the parent table of the Employee table via the Department_DepartmentID foreign key.
- The Department records are inserted first to ensure the foreign key references exist before inserting child records.
- The Employee records that reference DepartmentIDs are then inserted.
- Foreign key checks are disabled to allow inserting an Employee with an invalid foreign key reference.
- Foreign key checks are re-enabled after insertion is complete to restore validation.

Case 2:

```
Error Code: 1452. Cannot add or update a child row: a foreign key constraint
fails
(`dutchess_county_bus_transportation_dbms_project`.`bus_has_schedule`,
CONSTRAINT `fk_Bus_has_Schedule_Bus1` FOREIGN KEY
(`Bus_BusID`) REFERENCES `bus` (`BusID`))          0.047 sec
```

We used two ways after deletion :

```
SET SQL_SAFE_UPDATES = 0;
DELETE FROM Bus;
SET SQL_SAFE_UPDATES = 1;
DELETE FROM Bus
WHERE BusID > 0;
```

a) ALTER TABLE Bus AUTO_INCREMENT = 10;

b)
```
INSERT INTO Bus (BusID, BusNumber, Capacity, LicensePlateNumber, BusType)
VALUES
  (1, 'A', 50, 'ABC126','Coach'),
  (2, 'B', 60, 'GHI789', 'School Bus'),
  (3, 'C', 40, 'JKL012', 'Shuttle'),
  (4, 'D', 45, 'MNO345', 'Shuttle'),
  (5, 'E', 35, 'PQR678', 'Mini Bus'),
  (6, 'F', 30, 'STU901', 'Mini Bus'),
  (7, 'G', 35, 'STU905', 'Bus'),
  (8, 'H', 39, 'STU910', 'Mini Bus');
```

Description:

- To overcome this issue, we deleted the existing records and did this in two ways.
- By using the Alter table bus and by checking the schedule table with the bus table and updating the records manually.

9.2 IMPORTING DATA:

We took the data from the DCPT and entered it manually in the respective .csv file and imported that data safely using the following.

1. Import data from Bus.csv into Bus table

```
LOAD DATA LOCAL INFILE 'Bus.csv'
INTO TABLE Bus
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;
```

2. Import data from BusRoute.csv into BusRoute table

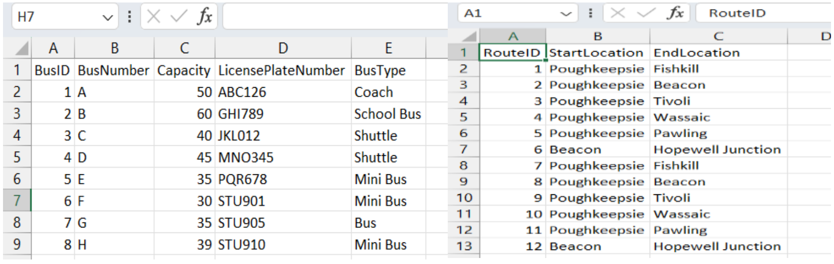
```
LOAD DATA LOCAL INFILE 'BusRoute.csv'
INTO TABLE BusRoute
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;
```

3. Import data from TicketType.csv into TicketType table

```
LOAD DATA LOCAL INFILE 'TicketType.csv'
INTO TABLE TicketType
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;
```

Description:

- Use LOAD DATA LOCAL INFILE to import CSV file.
- Specify CSV file path in 'filename'.
- Set the field separator, enclosure, and line terminator correctly.
- Use IGNORE 1 ROWS to skip header row.
- Match the columns in the CSV to the table columns.



BusID	BusNumber	Capacity	LicensePlateNumber	BusType
1	A	50	ABC126	Coach
2	B	60	GHI789	School Bus
3	C	40	JKL012	Shuttle
4	D	45	MNO345	Shuttle
5	E	35	PQR678	Mini Bus
6	F	30	STU901	Mini Bus
7	G	35	STU905	Bus
8	H	39	STU910	Mini Bus

RouteID	StartLocation	EndLocation
1	Poughkeepsie	Fishkill
2	Poughkeepsie	Beacon
3	Poughkeepsie	Tivoli
4	Poughkeepsie	Wassaic
5	Poughkeepsie	Pawling
6	Beacon	Hopewell Junction
7	Poughkeepsie	Fishkill
8	Poughkeepsie	Beacon
9	Poughkeepsie	Tivoli
10	Poughkeepsie	Wassaic
11	Poughkeepsie	Pawling
12	Beacon	Hopewell Junction

Figure 9.3 Usage of CSV files to load data

9.3 INSERTION OPTIMIZATION:

- Used bulk INSERT statements instead of separate INSERTs:

```
INSERT INTO Schedule (DayFlag, ArrivalTime, DepartureTime)
VALUES
  ('Monday', '06:00:00', '06:05:00'),
  ('Monday', '06:10:00', '06:15:00'),
  ('Tuesday', '07:00:00', '07:05:00'),
  ('Wednesday', '08:30:00', '08:35:00'),
  ('Thursday', '15:45:00', '15:50:00'),
  ('Friday', '13:10:00', '13:15:00'),
  ('Saturday', '11:15:00', '11:20:00'),
    ('Sunday', '09:30:00', '09:35:00');
```

- Disabled indexes and foreign key checks before insertion:

```
SET foreign_key_checks = 0;
ALTER TABLE Bus DISABLE KEYS;

-- Insert statements

ALTER TABLE Bus ENABLE KEYS;
  SET foreign_key_checks = 1;
```

- Used multiple VALUES lists in one INSERT statement:

```
INSERT INTO User (FirstName, LastName, DOB, Email, PhoneNumber,
Username, Password)
VALUES
  ('John', 'Doe', '1990-01-01', 'john@example.com', '123-456-7890', 'johndoe',
'password123'),
    ('Jane', 'Smith', '1995-05-15', 'jane@example.com', '987-654-3210', 'janesmith',
  'password456');
```

- Imported data from CSV using LOAD DATA instead of INSERTs:

```
LOAD DATA LOCAL INFILE 'Bus.csv'
INTO TABLE Bus
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;
```

This way we optimized insertion by reducing context switches, utilizing bulk inserts, and minimizing lagging.

9.4 INSERT STATEMENTS:

1. Insert schedules:

```
INSERT INTO Schedule (DayFlag, ArrivalTime, DepartureTime)
VALUES
  ('Monday', '06:00:00', '06:05:00'),
  ('Monday', '06:10:00', '06:15:00'),
  ('Tuesday', '07:00:00', '07:05:00'),
  ('Wednesday', '08:30:00', '08:35:00'),
  ('Thursday', '15:45:00', '15:50:00'),
  ('Friday', '13:10:00', '13:15:00'),
  ('Saturday', '11:15:00', '11:20:00'),
  ('Sunday', '09:30:00', '09:35:00');
```

2. Insert bus routes:

```
INSERT INTO BusRoute (StartLocation, EndLocation)
VALUES
  ('Poughkeepsie', 'Fishkill'),
  ('Poughkeepsie', 'Beacon'),
  ('Poughkeepsie', 'Tivoli'),
  ('Poughkeepsie', 'Wassaic'),
  ('Poughkeepsie', 'Pawling'),
  ('Beacon', 'Hopewell Junction');
```

3. Insert bus stops:

```
INSERT INTO BusStop (StopName, Location)
VALUES
  ('Poughkeepsie Station', '1 Station Plaza, Poughkeepsie, NY'),
  ('Beacon Station', '223 Fishkill Ave, Beacon NY'),
  ('Hopewell Junction', '123 Main St, Hopewell Junction, NY'),
  ('Tivoli', '456 Broadway, Tivoli, NY'),
  ('Fishkill', '789 Main St, Fishkill, NY'),
  ('Wassaic', '234 Rail Rd, Wassaic, NY');
```

4. Insert bus stop arrival times:

```
INSERT INTO RouteStopSequence (NumberofStops, ArrivalTime, BusStop_StopID)
VALUES
  (1, '06:00:00', 1),
  (2, '06:15:00', 2),
  (3, '06:30:00', 3),
  (4, '06:45:00', 4),
  (5, '07:00:00', 5),
  (6, '07:15:00', 6);
```

5. Assign buses to schedules:

```
INSERT INTO Bus_has_Schedule (Bus_BusID, Schedule_ScheduleID)
VALUES
  (1, 1),
  (2, 2),
  (3, 3),
  (4, 4),
  (5, 5),
  (6, 6),
  (7, 7),
  (8, 8);
```

6. Assign buses to routes:

```
INSERT INTO Bus_has_BusRoute (Bus_BusID, BusRoute_RouteID)
VALUES
  (1, 1),
  (2, 2),
  (17, 3),
  (18, 4),
  (19, 5),
  (20, 6);
```

7. Insert ticket types:

```
INSERT INTO TicketType (TicketTypeID, TypeName, Price, ValidityPeriod, Description)
VALUES
  (1, 'Day Pass', 5.00, 1, 'Valid for one day'),
  (2, '7-day Pass', 20.00, 7, 'Valid for 7 consecutive days'),
  (3, '31-day Pass', 70.00, 31, 'Valid for 31 consecutive days');
```

8. Insert data into User table:

```
INSERT INTO User (FirstName, LastName, DOB, Email, PhoneNumber, Username,
Password)
VALUES
  ('John', 'Doe', '1990-01-01', 'john@example.com', '123-456-7890', 'johndoe', 'password123'),
  ('Jane', 'Smith', '1995-05-15', 'jane@example.com', '987-654-3210', 'janesmith',
'password456');
```

9. Insert data into the Bus table:

```
INSERT INTO Bus (BusID, BusNumber, Capacity, LicensePlateNumber, BusType)
VALUES
(1, 'A', 50, 'ABC126','Coach'),
(2, 'B', 60, 'GHI789', 'School Bus'),
(3, 'C', 40, 'JKL012', 'Shuttle'),
(4, 'D', 45, 'MNO345', 'Shuttle'),
(5, 'E', 35, 'PQR678', 'Mini Bus'),
(6, 'F', 30, 'STU901', 'Mini Bus'),
(7, 'G', 35, 'STU905', 'Bus'),
```

10.Insert data into the Department table:

```
INSERT INTO Department (DepartmentName, Location)
VALUES
  ('Operations', '123 Main St, Poughkeepsie, NY'),
  ('Maintenance', '456 Park Rd, Beacon, NY');
```

11. Insert data into Employee table:

```
INSERT INTO Employee (FirstName, LastName, Position, Department_DepartmentID)
VALUES
  ('Sarah', 'Jones', 'Driver', 1),
  ('Mark', 'Lee', 'Mechanic', 2);
```

12. Insert data into Admin table:

```
INSERT INTO Admin (Username, Password, Email, PhoneNumber,
Employee_EmployeeID)
VALUES
  ('sarahj','password123', 'sarah@example.com','123-555-1234',1),
  ('markl','password456', 'mark@example.com','987-555-4321',2);
```

13. Insert data into Payment table:

```
INSERT INTO Payment (PaymentID, Amount, PaymentDate, User_UserID,
TicketType_TicketTypeID)
VALUES
  (1, 5.00, '2023-01-01', 1, 1),
  (2, 20.00, '2023-01-10', 2, 2);
```

10.REFERENCES

1. Dutchess County Public Transportation Application:
   https://www.dutchessny.gov/Departments/Public-Transit/Public-Transit.htm
2. NYC Transit: MTA Subway and Bus:
   https://transitapp.com/region/new-york
3. Moovit:
   https://moovitapp.com/nycnj-121/poi/en