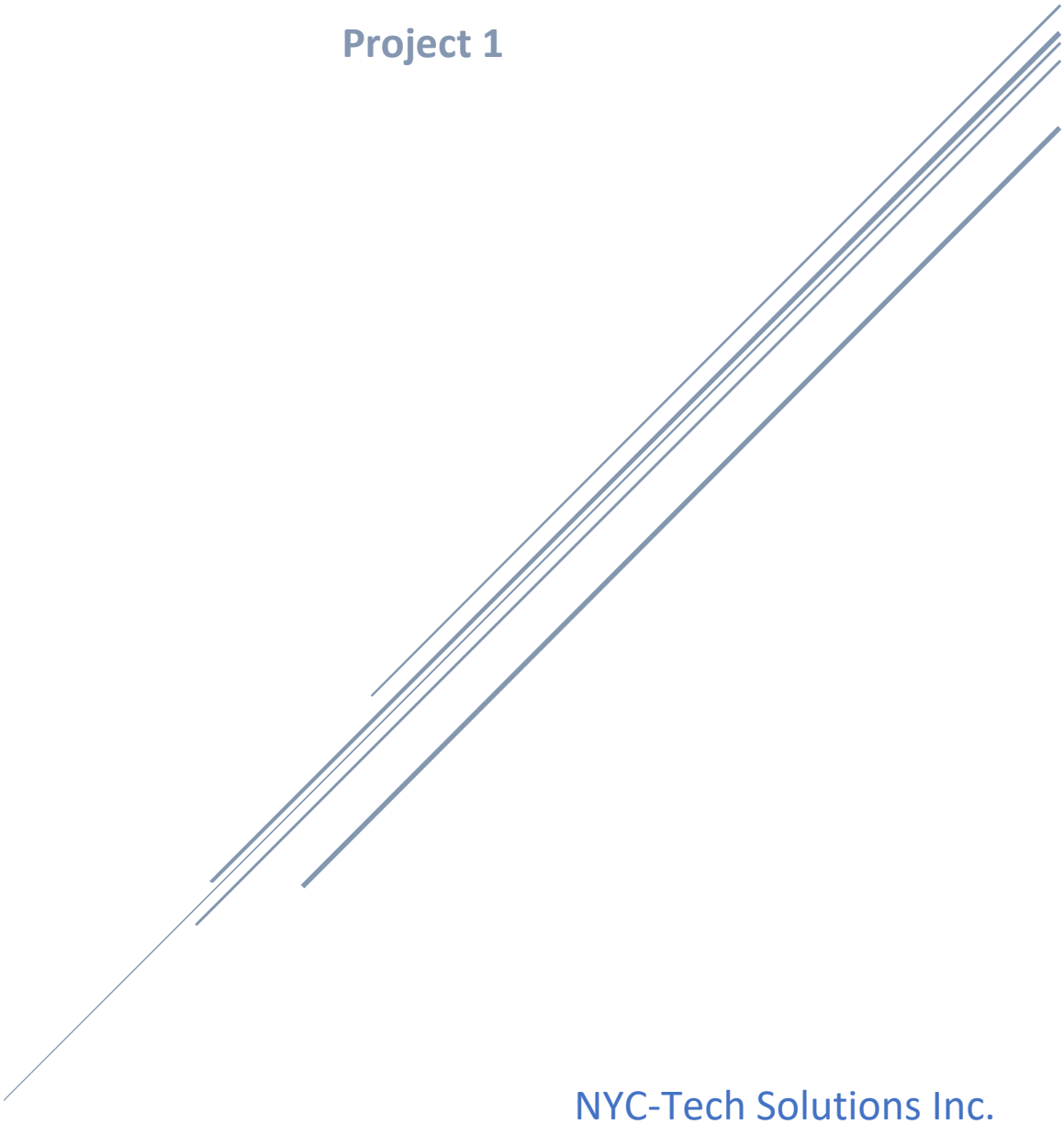
EZRENTAL POS WINDOWS APPLICATION DESIGN & IMPLEMENTATION

Auto Rental Point-of-Sales Management System

Project 1



NYC-Tech Solutions Inc.

Anderson Uribe Rodriguez

EXECUTIVE SUMMARY

An overview of this document, including deliverables and expectations for the project.

- This document provides the design and implementation of Client/Server Application Auto Rental Point-of-Sales Management System named EZRental POS, which include an e-commerce site named EZRental.com for NYC-Tech Solutions Inc.

- Provides an overview of the problem statement and objectives, along with the roles and responsibilities of those involved in the completion of the project.

- Business and technical requirements.

- Explanation of proposed application physical architecture, including the database management system physical architecture and the project methodology used to achieve the objectives.

- By the end, the Database design and implementation to support both the EZRental Point-of-Sales & Back-end Management Systems will be ready for interaction between the Database manager system and the user.

    - Includes Conceptual Model, Logical Model and Normalized Model
    - Data dictionary derived from the Normalized model
    - Physical Model Schema Diagram
    - Implementation and testing of database using Microsoft SQL Server

PROBLEM STATEMENT & OBJECTIVES

This section provides an overview of the problem presented and objectives of the project.

Project Objectives

- To design & implement a Client/Server Application Auto Rental Point-of-Sales Management System named EZRental POS, which includes an e-commerce site name EZRental.com.
- Basic objectives and architecture being targeted:
  - The EZRental POS System has been designed to allow customers, both retail and corporate, to reserve vehicles for renting like existing in-person or online car rental systems such as Avis, Hertz, Budget, etc.
  - The application was designed to support dozens of major cities around the world. In addition, provide a great user experience both in the physical rental agencies as well as online system with the best competitive pricing available in the market.
  - The company currently has rental agency branches in US, Canada, Mexico, United Kingdom, Japan & Australia and looking to expand further globally into other markets in Asia, Africa, and the Mediterranean.
- Analysis, Design, development, implantation, and testing of the database used by the Client/Server Application EZRental POS.

PROJECT ROLES & RESPONSIBILITIES

This section contains the roles and responsibilities for the members of the project. Their roles and individuals involved in this project are shown below.

Person	Role	Description
Mr. Rodriguez	**Program Manager & Project Manager**	▪ Owner of the project and liaison to Manage the EZRental Inc. ▪ Roles include but not limited to. 1. Owner of project responsible for the success of the project. 2. Project Management 3. Scrum Master that ensures the project stayed on time and moved in the right direction. Cleared any obstacles impeding the team's progress etc.
Consultant #1 (Mr. Rodriguez)	**Business & Database Analyst**	▪ Interviewed the stakeholders at **EZRental Inc**. And created the Business Requirements that were the foundation to the database design & implementation. ▪ Roles include but not limited to: 1. Engaged in discovery activities & interviewed the stakeholders at **EZRental Inc**. 2. From the interview and discovery ***created*** **1) ER/EER Conceptual Data Model from the business requirements & 2) Normalized Logical Model**.
Consultant #2 (Anderson Uribe)	**Database Developer**	▪ Used the Normalized Logical Model created by consultant #2 to create the Data Dictionary, Physical Schema Diagram, and Implemented the Database Application for the Auto Rental System. ▪ Roles include but not limited to: 1. Used the Normalized Logical Model created by consultant #2 to do the **following 1) Created Data Dictionary tables for each logical table targeting Microsoft SQL Server Data Types** & **2) Created Physical Schema Diagram**. 2. From these two deliverables, **1) implemented the Database Application using Microsoft SQL Server** for the Auto Rental System.
Consultant #3 (Anderson Uribe)	**Database Administrator**	▪ Installed the DBMS, maintained, and operated the DBMS throughout its lifetime. ▪ Roles include but not limited to: 1. As DB Admin, they **1) Setup & installed Microsoft SQL Server DBMS. 2) Microsoft SQL Server Management Studio Administrative tool**. 2. They also **3) Operated & Maintained the DBMS**.

Person	Role	Description
Consultant #4 (Mr. Rodriguez)	**Object-Oriented-Programming Architect**	▪ An Object-Oriented-Programming Architect was hired by Mr. Rodriguez that interviewed the stakeholders at **EZRental Inc.**, from a client application programming prospective and in addition designed the Class/Object model based on interview and analysis results. ▪ Roles include but not limited to: 1. Engaged in discovery activities & Interviewed the stakeholders at **EZRental Inc**. 2. From the interview and discovery **1) Designed/Architected the Object-Oriented-Programming Class/Object Model**. 3. From the interview and discovery **1) Designed a high-level Graphical User-Interface (GUID) wireframe**, & **2) front-end features & functionality**.
Consultant #2 (Anderson Uribe)	**Full Stack Application Developer**	▪ Object-Oriented-Programming developer which implemented the Windows Client application using **C# & .NET technologies** & 2) on the database side, implemented stored procedures and supported the databased team as needed. ▪ Roles include but not limited to: 1. As OOP developer, **1) Object-Oriented-Programming of Class/Object Model designed by Consultant #4 of the Windows Client/Server Application Client using C# & .NET technologies**. 2. In addition, **2) Database Stored Procedures and other development requirements in the Back-end DBMS**.
Consultant #2 (NA)	**Full Stack Web Developer**	▪ Object-Oriented-Programming developer & Web Developer that implemented the Web-based application using **C#, .NET technologies** and other technology & 2) on the database side, implemented stored procedures and supported the databased team as needed. ▪ Roles include but not limited to: 1. Web Developer, **1) Object-Oriented-Programming of Class/Object Model designed by Consultant #4 of the Web Client/Server Application Client using C# & .NET technologies & Other Web Technology** 2. In addition, **2) Database Stored Procedures and other development requirements in the Back-end DBMS**.

APPLICATION BUSINESS REQUIREMENTS

A business analyst interviewed EZRental Inc. to gather the necessary data required for the application and database design.

Business Requirements

About Us:

EZ-Car Rental is an auto rental company that rents vehicles such as cars, SUVs, minivans & cargo vans. In addition, specialized vehicles such as trucks, motorcycles, etc. We operate in several countries with rental agency locations in the US, Canada, Mexico, UK, Japan & Australia. In each country we operate, multiple rental agencies can exist in a city. For example, New York City has 2 rental agencies in Manhattan, one in Brooklyn and two in Queens, one in each airport. With multiple rental agencies in cities, a customer can pick up a vehicle in one location and drop it off at another.

Current Challenges:

Our current rental system is outdated, with a poor user-experience, inefficient (breaks often thus expensive to operate), does not meet our business requirements, and is not scalable (cannot be easily updated with new features). Also, very important the current system is not elastic since it does not give us the flexibility to scale-up or scale-down based on business trends and seasonal changes in the market.

We want to invest in modernizing our business with a new vehicle management system that can meet these challenges and give us: a great user-experience, meet our business new requirements, scalable, and elastic to adopt to business trends and seasonal market changes. Elasticity is very important since we are also faced with a new type of competition; small rental companies that are nimble and can quickly adopt to market changes thus able to provide new offerings that are appealing to customers thus affecting our profits. These smaller competitors are using new technologies that enable them to be nimble and elastic. Figurative speaking "*they are eating our lunch*".

We look forward to your proposed architecture & implementation of this new system. Below are our business requirements.

Our Agencies:

A rental agency is identified by a unique number *rental agency ID*, *agency name*, *address* that is composed of the following elements: *address line1, address line 2*, *city*, *state code*, *zip code* & *country*. In addition, we also need to capture the agency's *phone number*, and *email*.

Our Customers:

EZ-Car Rental offer their services to two types of customers: corporate customers & retail customers. Corporate Customers are individuals whose corporation have a contract with us and get special corporate rates for their employees. On the other hand, retail customers are consumers not associated with a company.

To run our business, the application must store the following information for both type of customers (retail & corporate):

- A *Customer ID* number which uniquely identifies the customer, *customer name* which is composed of: *first name*, *last name*.
- *Birth date*, *Age*, *Address* which includes the elements: *address line1, address line 2*, *city*, *state code*, *zip code* & *country*.
- Agency *phone number* & *email* which is required to rent. In addition, the unique *driver license number* and *driver license expiration date*.
- Another very important attribute we need to capture for every customer is the *credit card*. You cannot rent one of our vehicles without a credit card. A *credit card* includes the following components: *credit card number* that uniquely identifies the credit card, credit card *owner name*, *merchant name*, *expiration date*, *billing address* composed of *address line1, address line 2*, *city*, *state code*, *zip code* & *country*. Other attributes of credit card are *credit card balance*, *credit card limit* & *activation status* which is true if the credit card is active and can be used or false when disabled.
- Business rules related to a credit card are:
  - A customer can have many credit cards they can use to pay for rental transactions.
  - A credit card can be co-owned by many individuals such a family member or corporate entity the customer works for.

Business Requirements

Our Customers (Cont.):

For our corporate customers only, we must store the following properties: unique *company ID* (we have an ID number for each company), *company name*, company address which includes the elements: *address line1, address line 2*, *city*, *state code*, *zip code* & *country*, in addition, *company contact* which is composed of *contact name*, *contact phone number* & *contact email*. Finally, we need to store the *company's daily rental rate* or rate applied to the corporate customers rentals.

Retail customers can opt-in to enrolled in the EZPlus rewards program where they earn points every time they rent and can redeem these points for future rentals. Note that the EZPlus program is optional for retail customers & points are earned only when they rent a vehicle. In addition, retail customers are eligible for special promotional discounts or coupons they can obtain from other businesses and organizations. Therefore, data unique to a retail customer that we need to capture for the promotional discount are: unique random number *discount ID* to uniquely identify a discount, a unique *discount code* or coupon code. and *discount code description*. For the EZPlus rewards program we need to store: unique random *EZPlus ID*, the unique *Ezplus rewards code*, *EZPlus rewards earned points*. Examples of common *discount ID*, *discount code*, *discount code description*, *EZPlus ID*, *EZPlus rewards Code* and *EZPlus earned points* are:

Discount ID	*Discount Code*	*Discount Code Description*
1234..	AAA99700	**AAA Membership Discount - 25% off base rate plus 10% donated for breast cancer research.**
5678..	GOV87569	**Government Employee Discount - 30% off base rate**
9101..	*STA34156*	**State Employee Discount for 25% off base rate**
1213..	VET20551	**Veteran Discount 35% off base rate Plus 10% donation to veteran's family fund.**
Etc..	Etc..	**Etc..**

EZPlus ID	*EZPlus Rewards Code*	*EZPlus Rewards Earned Points*
1234..	EZP90098	**10000**
5678..	EZP10001	**500**
9101..	*EZP64932*	**159000**
1213..	*EZP20051*	**23000**
	Etc..	**Etc..**

In this business, we have the following rules for our customers:

- We only have two types of customers retail customer or corporate customers. No other type of customer exists.
- A customer *cannot* be a retail & corporate customer at the same time. A customer can only rent as a retail customer or as a corporate and these transactions must be separate. We don't want our customers to be able to combine both retail customer discounts, rewards program, and corporate rates at the same time.

Business Requirements (Cont.)

Our Vehicles:

EZ-Car Rental needs a system to manage their vehicles for renting, maintenance, selling, etc. Vehicles are classified into4 main types: cars, SUVs, minivans, and cargo vans. These are the vehicles most rented and available at every rental agency. Nevertheless, there are other categories of vehicles available only certain locations such as recreational vehicle, motorcycles etc. No matter what type of vehicle, all vehicle types of vehicles share the following common characteristics:

- Each vehicle is identified by the random number *vehicle ID*. In addition, each vehicle is also identified by the alpha-numeric vehicle *VIN number*. Other attributes include the *vehicle name* composed of *make*, *model*& year.
- Additional attributes are *color*, also the *licenseplate* composed of the following components: *license plate number*, *license plate state*. More attributes are *mileage*, *transmission type* (e.g., Manual, automatic, Continuously variable transmission (e.g. CVT), Semi-automatic & dual-clutch)and *seat capacity*.
- All vehicles also have a special identifier we use to track the vehicle status named *vehicle status ID*. This is a unique number that identifies the status of a vehicle, which works in conjunction with *vehicle status description* which describes the status, such as reserved, rented, available, maintenance, not available, transferred, etc. Below is the list of vehicle status IDs we are currently using and their descriptions:

Vehicle Status ID	*Vehicle Status Description*
1	**Reserved.**
2	**Rented.**
3	**Available.**
4	**Not available**
5	**Maintenance**
6	**Transferred to another agency**

In addition to these attributes shared by all vehicles, the unique characteristics for each of the 4 vehicle types available in all agencies are as follows:

- A Car is a vehicle whose *trunk capacity* measured in cubic feet volume is advertised to our customers. Customers can decide which vehicles better fits their needs based on the number of luggage they are carrying etc. For example, a luxury Mercedes E class car has a trunk capacity of 18.5cubic ft.
- An SUV has a *towing capacity* in pounds. Towing capacity is number in pounds or could also be a decimal in pounds. For example, some of our SUV have a maximum towing capacity of 3,000 pounds. Another attribute of SUV is classification if the SUV is *All-Wheel-Drive*or not which is a yes/no or true/false option.
- A Minivan has the option of having a *disability option package* or not or true, false.
- Finally, a Cargo Van, has a *cargo capacity* in cubic feet volume. For example, the typical volume of our Vans is 245 cubic feet (cu.ft.). Cargo Vans also have a *maximum payload* attribute that determines how much weight in pound it can hold. Our vans have a typical max load of 3,880 lbs.

As stated previously, there are other types of vehicles of interest that in some location we may want to store data on other than car, SUV minivans and cargo van. In addition, a reservation or rental can only be for one of these four categories of vehicles not a combination. You can only rent either a car, SUV minivans, cargo van or other for a reservation or rental, not a combination such as a car & SUV at the same time. Each reservation is unique to one vehicle.

In our business, we have the following business rules for our vehicles:

- Every vehicle is owned by one agency. The vehicle can be pick-up and dropped-off at any agency, but only one agency is the vehicle's owning agency. An agency can own many vehicles, but a vehicle can only be owned by one agency.
- A vehicle can currently be located at any agency depending on where it was dropped-off after a rental. We need to track the current agency where the vehicle is located, to arrange a transfer or a rental that will ultimately direct the vehicle to the owning agency.

Business Requirements (Cont.)

Reservation Process:

A vehicle must first be reserved before the vehicle can be rented. There is a distinction between a reservation and a rental. A reservation guarantees a vehicle will be ready for you to be pick-up and rented. A rental means a customer complied with the reservation and rented the vehicle.

We have the following rules for reserving a vehicle:

- A reservation is not made for a specific vehicle, but to a vehicle rental category. Rental category examples are economy, intermediate, full size, luxury.
- Thus, a customer makes a reservation of a vehicle rental category at a rental agency. Therefore, the reservation process involves a customer a vehicle rental category and the rental agency.

A rental category contains a list of vehicles depending on the vehicle type: Car (economy, intermediate, full size, luxury), SUV (standard, full size etc.), or Cargo Van etc. Each of these categories have a different price range. Therefore, for a vehicle rental category we need to capture the unique *vehicle rental category ID* that identifies the category of the vehicle being reserved or rented, *category name* and finally *category daily rental rate* for the category. We used a specific code for our vehicle rental category ID, category name & daily rental rate. The table below shows the ID, category names and cost we use:

Vehicle Rental Category ID	*Vehicle Rental Category Name*	*Category Daily Rental Rate*
1	**Car-Economic**	**$113.99**
2	**Car-Compact**	**$115.99**
3	**Car-Intermediate**	**$116.67**
4	**Car-Standard**	**$119.99**
5	**Car-Full Size**	**$121.99**
6	**Car-Premium**	**$127.79**
7	**Car-Luxury**	**$139.99**
8	**SUV-Intermediate**	**$127.99**
9	**SUV-Standard**	**$128.99**
10	**SUV-Standard Elite**	**$135.99**
11	**SUV-Full Size**	**$148.99**
12	**SUV-Premium**	**$157.99**
13	**Minivan-Standard**	**$152.99**
14	**Van-Passenger Van (12 passengers)**	**$161.00**
15	**Van-Cargo Van**	**$19.95**
16	**Pick Up-Mid Size**	**$69.95**
17	**Pick Up-Full Size**	**$105.99**
18	**Motorcycle-Touring**	**$19.95**
19	**Motorcycle-Cruiser**	**$199.99**
20	**Motorcycle-Scooter**	**$79.95**

We have the following business rule relate to a vehicle and a vehicle rental category:

- A vehicle is a member of a vehicle rental category.
- A vehicle rental category can have one, none or many vehicles belonging to that category at any given time, nevertheless, a vehicle can only belong to one vehicle rental category.

As stated previously, a customer makes a reservation of a vehicle rental category at a rental agency. Therefore, the reservation process requires the customer, vehicle rental category & rental agency for a reservation to be made. The following rules apply to a reservation:

- A vehicle can be reserved to be picked up at the **INDICATED** rental agency and dropped off at the **SAME** rental agency.
- A vehicle can be reserved to be picked up at the **INDICATED** rental agency and dropped off at a **DIFFERENT** rental agency.
- A reservation is made only for one pick-up rental agency, but a rental agency can have many reservations for pick-ups taking place.
- A reservation can only be for one drop-off rental agency, but a rental agency can have many reservations drop-offs taking place.

When a customer reserves a vehicle category for a specific rental agency, we wish to capture the following:

- A unique *reservation ID* to track the reservation, the *reservation pick-up rental agency* or the rental agency where the vehicle will be picked up, and the target *reservation drop-off rental agency*.
- In addition, we need *reservation pick up date*, *reservation pick up time*, *reservation drop off date* and *reservation drop off time*, also the *reservation estimated rental cost*.

Business Requirements (Cont.)

Reservation Process (Cont.):

- Finally, we need to store the unique *reservation status ID* which is a unique number we use to indicate the status of a reservation and *reservation status description* which describe each of the status such as: confirmed, cancelled, completed etc. Below is an example of the reservation status ID we use and description for each status.

Reservation Status ID	*Reservation Status Description*
1	**Confirmed.**
2	**Modified & reconfirmed.**
3	**Cancelled & Closed.**
4	**Fulfilled & Closed.**
Etc..	**Etc..**

For a reservation we must adhere to the following rules:

- A customer can make none, one or many reservations for a vehicle rental category at a rental agency.
- A rental category can be reserved by none, one or many customers at a rental agency.
- A rental agency can get many or no reservations for a vehicle rental category by a customer.
- A reservation can only have one pick-up rental agency location, but a rental agency can have many reservation pick-ups happening.
- Each reservation has a drop-off rental agency (may be different than pick-up rental agency). A reservation can only have one drop-off rental agency location, but a rental agency can have many reservation drop-offs taking place.

The Rental Process:

Once a vehicle has been reserved, the vehicle can be rented (picked up/dropped off) as per the scheduled of the reservation agreement. A rental means a customer complied and fulfilled the reservation and rented the vehicle.

For the rental process, the following rules apply:

- A customer rents a vehicle at a rental agency. This means the rental process requires the customer, vehicle, and & rental agency for a rental to be complete.
- During the rental process we may have any of the following scenarios:

1. A vehicle can be picked up at the **SAME** rental agency as indicated by the reservation and dropped off at the **SAME** rental agency.
2. Or a vehicle can be picked up at the **SAME** rental agency as indicated by the reservation and dropped off at **ANOTHER** rental agency.
3. Or a vehicle can be picked up at **ANOTHER** rental agency other than what was indicated by the reservation and dropped off at **SAME** rental agency of the reservation.
4. Or finally, a vehicle can be picked up at **ANOTHER** rental agency other than what was indicated by the reservation and dropped off at **ANOTHER** rental agency of the reservation.

- ❖ Note that for scenarios 3 & 4, we cannot guarantee that the vehicle rental category of the reservation will be available at the agency other than what was agreed in the reservation. We will do our best to accommodate the change during these scenarios or find another vehicle that will be closed to the original reservation.

- A rental can only be for one pick-up rental agency, but a rental agency can have many rental pick-ups taking place.
- A rental can only be to one drop-off rental agency, but a rental agency can have many rental drop-offs taking place.

When a customer rents a vehicle at the rental agency, we need to capture the following information about the rental:

- The *rental agreement ID* that uniquely identifies the rental transaction, *rental pick up date*, *rental pick up time*, *rental drop off date* and *rental drop off time*, *rental pick up odometer value*, *rental drop off odometer value* & *rental total cost* which can be calculated based on selected fuel option, insurance option, vehicle rental category price and other factors.

Business Requirements (Cont.)

The Rental Process (Cont.):

- In addition to the above, customers receive a vehicle with a full tank of gas and customers have the option to return the car on a full tank of gas they purchase or pay a charge to return the car as is, therefore, we need to capture the unique *rental fuel option ID*, *rental fuel option description* and *rental fuel option additional cost*. We currently use the following fuel option IDs, descriptions, and cost:

Rental Fuel Option ID	*Rental Fuel Option Description*	*Rental Fuel Option Additional Cost*
1	**Return with a full tank or on return, pay for gas that is missing.**	**Calculated during car return and based on the current price of a gallon of gas. Price will vary.**
2	**Pay for full tank in advanced at time of rental, return car empty. No refund for unused gas.**	**Calculated during time of car rental and based on current price of a gallon of gas. Price will vary.**

- Also, we give customer options for car insurance & protection, therefore we need to capture the unique *insurance option ID*, *insurance option description* and *insurance option additional cost*. We currently use the following insurance option IDs, descriptions, and cost:

Rental Insurance Option ID	*Rental Insurance Option Description*	*Rental Insurance Option Additional Cost per Day*
1	**No insurance. Opt-out.**	**$0.00**
2	**Collision Damage Waiver Max - Agency will pay for damage, lost or stolen vehicle.**	**$49.99**
3	**Collision Damage Waiver 3000 - Agency will pay for first $3,000 of loss or damage, renter pays all loss & damage after $3,000.**	**$39.99**
4	**Lability Extended Protection – Agency provides renter with third party liability protection up to $1 Million per accident for bodily injury or death or property damage to others.**	**$89.99**
5	**Roadside Assistance Plus – 24/7 roadside assistance, replacement for lost keys, flat tire service, fuel delivery, etc.**	**$15.99**

- Other attributes required for the rental that we need to capture are the unique *rental status ID* & *rental status description*. We currently use the following rental status IDs & descriptions:

Rental Status ID	*Rental Status Description*
1	**Picked up as scheduled.**
2	**Dropped off as scheduled.**
3	**Returned late**
4	**In progress.**
5	**Roadside assistance in progress.**
7	**Unknown**

Business Requirements (Cont.)

The Rental Process (Cont.):

- Finally, we need to capture the *rental deposit* for a rental. The rental deposit value is calculated based on the **rental period + 25% of the rental period** for any damage or other charges. This deposit is refunded to the customer's credit card when the vehicle is returned in the condition in which it was rented.

We need to be able to associate a reservation to a rental and vice versa, therefore we maintain the following additional business rules for our rental & reservation:

- A reservation is made for a rental and the opposite holds true; a rental is based on a reservation.
- But NOT all rentals are based on a reservation. We allow a customer to walk into a rental agency and rent a vehicle without a reservation.
- When a reservation is made for a rental, then it must be for only one rental, and a rental can be for a reservation but not mandatory since a customer can walk into an agency and rent a vehicle without a reservation.

Our Employees:

EZ-Car Rental employees consist of customer service agents who interact with our customer to reserve and rent vehicles. In addition, we have auto specialists who work in our services centers servicing our vehicles. In addition, drivers to transport our vehicles from one agency to another and maintenance personnel who maintain our agencies and finally our business team that handles the day-to-day business activities in our agencies and other roles. For now, we are only interested in storing the following data for all these types of employees:

- An *Employee ID* which uniquely identifies the employee, *employee name* which is composed of: *first name*, *last name*, also *employee address* which includes the components: *address line1, address line 2*, *city*, *state code*, *zip code* & *country*. Also, *employee phone*, *employee job title* and *employee email.*

Security & Access:

To access our systems proper security and authentication is required. Only authorized users can have access our agencies Point-0f-Sales & Back-End Management systems. In addition to our **EZRental.com** portal by our customers. Therefore, due to security and regulatory compliance purpose, we want to separate the employee access data from the customer access data by using two separate user accounts:

- Employee user accounts
- Customer user accounts

Security Access for Employees to Computer Systems in our Agencies (Employee User Accounts):
For our authorized employees & customer service employees to access the agencies Point-0f-Sales & Back-End Management systems they need to log in by entering a username & password for access to the application. This means every employee owns an employee user account.

An employee user account should store the user *employee user account ID* a unique identifier alpha-numeric string that identifies the employee user account, *employee username* another unique alpha-numeric that identifies each individual user, and finally the *employee password* alpha-numeric that is known only to the user, An employee can own one employee user account only, and an employee user account can only be owned by one employee only since the user account represents the identify of that one employee.

Security Access for our Customers who register for our EZ-CarRental.com web site (Customer User Accounts):
Customer who accesses our online portal to reserve and rent our vehicles also need a username and password to access our system, therefore each customer owns a customer user account.

A customer user account should store the user *customer user account ID* a unique alpha-numeric string identifier that identifies the customer user account, *customer username* another unique alpha-numeric value that identifies each customer, and finally, the *customer password* that is an alpha-numeric known only to the customer. A customer can own one customer user account only, and a customer user account can only be owned by one customer. For a period, we will need to register customers into our business but the **EZRental.com** web portal may be incomplete, therefore creating a customer user account for a new customer can be optional. We will force the creation of customer user accounts when they login to our portal for the
first time.

Business Requirements (Cont.)

Vehicle Transportation:

We need to know where our vehicles are located at all times, such as at the Rental Agency that owns the vehicle, another Rental Agency that does not own the vehicle, being transported from one Rental Agency to another as a result of a vehicle transfer after a rental to the owning rental agency, being transported as a new delivery to a Rental Agency from our distribution center, being transported for maintenance, or currently being rented by a customer. Vehicles need to be tracked or location status known. At this time, we are only interested in tracking when a vehicle is transported from one Rental Agency to another Rental Agency under the following scenarios:

- Vehicle can be located at a Rental Agency that does not own the vehicle after a rental dropping off at a different location than the picked up owning Rental Agency, thus vehicle eventually needs to be transported and delivered to the owning agency.
- Another non-owning Rental Agency requests support from other Rental Agency(s) for loans of vehicle(s) to borrow due to an unexpected busy period and requesting agency is short on inventory. After the first agency is done with the loaner vehicles, these vehicles need to be returned to the borrowed owning Rental Agency(s).
- In our current process & systems we currently use the following reason IDs and reason descriptions:

Transport Reason ID	*Transport Reason Description*
1	Rental Drop off at different location
2	Vehicle Loaned to another Agency
3	Pick up from Distribution Center
4	Drop off to Distribution Center
5	Vehicle sent for maintenance
7	Unknown

Note that transportation to and from Rental Agency is executed by an employee who is part of a transportation team or drivers. Therefore, when an employee executes a transport request of a vehicle to and from Rental Agencies, we need to capture the following information:

- *Transport pickup agency ID, Transport drop-off agency ID, Driver departure date, driver departure time, vehicle pick up date, vehicle pick up time, transport completed arrival date, transport completed arrival time, estimated arrival date, estimated arrival time*, & actual *transport time to completion*.
- In addition, we need to know at any time the transport status and transport status description of the transfer, such as: transfer completed, on route to pick up location, on route from pick up location, etc. Currently we track a transportation event using the following ID and description:

Transport Status ID	*Transport Status Description*
1	Transport completed
2	On route to pick up location.
3	On route from pick up location
4	At pickup location. In progress (Loading etc.)
5	Pickup location delay
7	Unknown

The goal again is to be able to know where our vehicles are always located and status.

Conclusion:

The business data listed in this business requirements document is what we need to capture for our business to operate. As our business evolve, additional data will be required. We will address these new requirements in future versions of the application. For example, invoice processing & employee management at our rental agencies are features on our roadmap. Therefore, our expectations is that the design is modular and scalable for future growth.

APPLICATION DEVELOPMENT& TECHNICAL REQUIREMENTS

An Application Analyst/Architect interviewed EZRental Inc., the project Business Decision Makers (BDMs), stakeholders and Information System Technical Decision Makers (TDMs) to compile the requirements below.

Application Development & Technical Requirements

Introduction & Current Challenges

As described in the Business Requirements, the current rental system is outdated, with a poor user-experience, breaks often thus expensive to operate, does not meet our business requirements, and is not scalable so it cannot be easily updated with new features etc. Also, not elastic since it does not give us the flexibility to scale-up or scale-down based on business trends and seasonal changes in the market. We want to invest in modernizing our business with a new vehicle management system that can meet these challenges and give us a great user-experience, meet new business requirements, scalable, and elastic to adopt to business trends and seasonal market changes.

We have an outdated IT infrastructure in our datacenter and there is a current initiative to modernize our datacenter and also leverage cloud technology in a hybrid environment to save on cost, streamline our operations and drive innovation.

We look forward to your proposed architecture & implementation of this new system that will meet these requirements. Next sections contain the results of our application development & technical requirements.

Rental Agencies Application & Technical Requirements:

The rental agencies are location where our customers both Retail & Corporate will engage our *Customer Service Representatives* to engage in rental/return activities in addition to other transactions such as registering, searching & updating customer information etc. Therefore, the application in the rental agencies is vital to the user-experience for both our *Customer Service Representatives* as well as our *Customers*.

We are forecasting that is some locations such as major city centers and airports, there will be many customers engaging throughout the day thus increasing the risk of a poor customer experience in addition to the work overload and poor experience for our *Customer Service Representatives*. We want our *Customers* to be serviced quickly and efficiently with a great experience, and our *Customer Service Representatives* to be able to process each *Customer* easily and effectively. With these criteria in mind, the application at our rental agencies must adhere to the following requirements:

Rental Agency Application Architecture Requirements:

Below are the requirements for the application used in our rental agencies by our customer service representatives, inventory team, service personnel and other employees working in our agencies:

1. Client application processing, transaction and response must be fast to minimize service time for a customer.
2. All transaction processing should be done in the user's computer or desktop for fast processing and response.
3. Application Architecture must be reusable and scalable to support future updates and new feature enhancements, without a long development lifecycle.
4. Depending on the architecture NYC-Tech Solutions Inc., decides for the application in the rental agencies (Desktop client or Web client), the primary Application Development Platform we use is ***C# & .NET technologies***. For any Web related development, we support JavaScript, React, NodeJs and other standard Web Technologies. We have aligned ***C#/.NET*** & **Web** developers that have been assigned to assist, support and update the application once NYCTech consultants complete the project and development of this system.
5. Rental Agency Desktop Application Security Authentication System – Proper security and authentication must be implemented to make sure only authorized customer service representative and other rental office employees can access the Point-0f-Sales with appropriate conditional access.

Application Development & Technical Requirements (Cont.)

Rental Agency Application Features and Functionalities Requirements:

The list of features and functionalities that we have compiled for the rental agencies' application are listed in the table below:

No.	Feature	Functionalities
1	**EZRental** Rental Agency Point-of-Sales (POS) System	▪ Car Rental, Car Return, New Customer Registration & Search Customer Information, Customer Update, Customer Deletion, Customer Listing operations etc.
2	**EZRental** Rental Agency Back-Office Vehicle Inventory Management System	▪ Back-office system meant for employees to perform bulk IN-MEMORY inventory processing or management tasks on vehicles such as adding vehicles to the system, searching for vehicles, updating vehicles etc. ▪ This system is NOT meant for Point-of-Sales, but for the inventory management employees who need to search, add, remove etc., a large/bulk number of vehicles or employees during a session. ▪ Back-office vehicle Management features – Allows inventory personnel and employees to bulk-manage Cars, SUVs, Mini-Vans, Cargo Vans to be searched, added, removed, printed, listed etc.
3	**EZRental** Rental Agency Back-Office Credit Card Management System	▪ The EZRental Credit Card Management System is a Back-office system meant for the Credit Card Department Employees to manage Credit Card Information. These uses can Search, Add, Edit & Delete credit card information in the database
4	**EZRental** Rental Agency Back-Office Employee & Customer User Account Management System	▪ The EZRental Customer & Employee User Account Management System is a Back-end system meant for IT ADMINISTRATOR Employees to manage both Employee & Customer USER ACCOUNTS.
5	**EZRental** Rental Agency Desktop Application Security Authentication System	▪ Proper security and authentication must be implemented to make sure only authorized employees can access the Point-0f-Sales, Back-End Management system or any other access to the applications.

Rental Agency Application Graphical User Interface Requirements:

- Graphical User-Interface should be fast rendering and user-friendly workflow.
- Visual screens or forms should be rich in color and appearance and navigation flow should be flexible and easy.
- The following UI controls or data field need to be pre-populated in GUI Screens:
  - **Addresses**
    - Any forms/UI which contains addresses, the STATE & COUNTRY fields should be automatically populated with a list of STATES or COUNTRIES, so the user does not have to manually enter a state or a country and simply select from drop-down list etc.
  - **Discount Codes:**
    - UI screens with customer's DISCOUNT CODE fields should be prepopulated with discount codes. The idea is the user should be able to select the discount to apply to a customer entry from a drop-down list/Combo Box etc. Note that this may or may not include the Discount Code Description on the UI screen as well.
    - Also note that the DISCOUNT CODE VALUES are generated by our Marketing Team and need to be pre-populated in the database before a code can be used. Therefore, the discount codes are prepopulated in the database.
    - Currently, when the Marketing Team generates a new code, they make the request to the database administrator to manually enter an update any new Discount Codes.
    - In the future, we want the application to have the necessary features for the Marketing Team to be able to manage the discount codes. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

Rental Agency Application Graphical User Interface Requirements (Cont.):

- **EZPlus Rewards Codes:**
  - The EZPlus Reward UI screens with customer's EZPLUS REWARDS CODE fields should be prepopulated with the EZPlus Rewards code for the customer is being applied to. The idea is the user should be able to select the EZPLUS REWARD CODE to apply to a customer entry from a drop-down list/Combo Box etc., or be handled by the back-end database.
  - **Important:** The EZPLUS REWARDS CODE VALUES are NOT generated by a business entity in our organization, but AUTOMATICALLY GENERATED by the application on the fly when registering a new customer. This is a different approach compared to the DISCOUNT CODE which are generated by Marketing Team. In this case, the EZPlus Rewards Code values are generated by the application and available via the UI screen to be used or some other method of generation.
  - To finalize this requirement, the idea is the EZPlus Rewards Code should be automatically generated and either appear in the UI Screen or automatically generated in the database.

- **Company Name:**
  - UI screens with corporate customer's COMPANY NAME fields should be prepopulated with the list of corporations that are members of our corporate program, which enables our users to avoid having to manually enter the company name. Note that this may or may not include the Company ID in the UI Screen which is a unique number with business value that we assign to each company.
  - Note that the company names. Company ids and other company data are managed by our Corporate Sales Team and need to be pre-populated in the database before any corporate customer processing can be made. Therefore, the company information is prepopulated in the database.
  - Currently, when the Corporate Sales Team adds a new corporation or company into the program, they make the request to the database administrator to manually enter and add the new company to the database.
  - In the future we want the application to have the necessary features for the Corporate Sales Team to have the functionality to manage the data of our corporate companies via the application. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.
  -

- **Vehicle Status:**
  - UI screens for vehicle inventory management, VEHICLE STATUS field should be prepopulated with the list of vehicle status. Based on the business requirements, the current list of vehicle status is listed in table below:

Vehicle Status ID	*Vehicle Status Description*
1	**Reserved.**
2	**Rented.**
3	**Available.**
4	**Not available**
5	**Maintenance**
6	**Transferred to another agency**

  - Currently populating the database with a vehicle status record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the vehicle status data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

- **Rental Agency:**

  - UI screens that required adding or managing a RENTAL AGENCY field should be prepopulated with the list of rental agencies in our company.
  - Currently populating the database with a rental agency record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the rental agency data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

Rental Agency Application Graphical User Interface Requirements (Cont.):

- **Vehicle Rental Category:**
  - UI screens that require the use of the VEHICLE RENTAL CATEGORY fields, must be prepopulated with the list of vehicle rental categories. Based on the business requirements, the current list of vehicle rental categories is as follows:

Vehicle Rental Category ID	*Vehicle Rental Category Name*	*Category Daily Rental Rate*
1	Car-Economic	$113.99
2	Car-Compact	$115.99
3	Car-Intermediate	$116.67
4	Car-Standard	$119.99
5	Car-Full Size	$121.99
6	Car-Premium	$127.79
7	Car-Luxury	$139.99
8	SUV-Intermediate	$127.99
9	SUV-Standard	$128.99
10	SUV-Standard Elite	$135.99
11	SUV-Full Size	$148.99
12	SUV-Premium	$157.99
13	Minivan-Standard	$152.99
14	Van-Passenger Van (12 passengers)	$161.00
15	Van-Cargo Van	$19.95
16	Pick Up-Mid Size	$69.95
17	Pick Up-Full Size	$105.99
18	Motorcycle-Touring	$19.95
19	Motorcycle-Cruiser	$199.99
20	Motorcycle-Scooter	$79.95

  - Currently populating the database with vehicle rental category records is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the vehicle rental categories data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

- **Reservation Status:**

  - UI screens that require the use of the RESERVATION STATUS field, must be prepopulated with the list of reservation status data. Based on the business requirements, the current list of reservation status is as follows:

Reservation Status ID	*Reservation Status Description*
1	Confirmed.
2	Modified & reconfirmed.
3	Cancelled & Closed.
4	Fulfilled & Closed.
Etc..	Etc..

  - Currently populating the database with a reservation status record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the reservation status data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

Rental Agency Application Graphical User Interface Requirements (Cont.):

- **Rental Status:**
  - UI screens that require the use of the RENTAL STATUS field, must be prepopulated with the list of rental status data. Based on the business requirements, the current list of rental status is as follows:

Rental Status ID	*Rental Status Description*
1	**Picked up as scheduled.**
2	**Dropped off as scheduled.**
3	**Returned late**
4	**In progress.**
5	**Roadside assistance in progress.**
7	**Unknown**

  - Currently populating the database with a rental status record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the rental status data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

- **Rental Fuel Option:**

  - UI screens that require the use of the RENTAL FUEL OPTION field, must be prepopulated with the list of rental fuel options data. Based on the business requirements, the current list of rental fuel option is as follows:

Rental Fuel Option ID	*Rental Fuel Option Description*	*Rental Fuel Option Additional Cost*
1	**Return with a full tank or on return, pay for gas that is missing.**	**Calculated during car return and based on the current price of a gallon of gas. Price will vary.**
2	**Pay for full tank in advanced at time of rental, return car empty. No refund for unused gas.**	**Calculated during time of car rental and based on current price of a gallon of gas. Price will vary.**

  - Currently populating the database with a rental fuel option record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the rental fuel option data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

Application Development & Technical Requirements

- **Rental Insurance Option:**

  - UI screens that require the use of the RENTAL INSURANCE OPTION field, must be prepopulated with the list of rental insurance options data. Based on the business requirements, the current list of rental insurance option is as follows:

Rental Insurance Option ID	*Rental Insurance Option Description*	*Rental Insurance Option Additional Cost per Day*
1	**No insurance. Opt-out.**	**$0.00**
2	**Collision Damage Waiver Max - Agency will pay for damage, lost or stolen vehicle.**	**$49.99**
3	**Collision Damage Waiver 3000 - Agency will pay for first $3,000 of loss or damage, renter pays all loss & damage after $3,000.**	**$39.99**
4	**Lability Extended Protection – Agency provides renter with third party liability protection up to $1 Million per accident for bodily injury or death or property damage to others.**	**$89.99**
5	**Roadside Assistance Plus – 24/7 roadside assistance, replacement for lost keys, flat tire service, fuel delivery, etc.**	**$15.99**

  - Currently populating the database with a rental insurance option record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the rental insurance option data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

Application Development & Technical Requirements (Cont.)

Customer Facing Self-Service Web-Portal Application Architecture Requirements:

We now address architecture requirements for the application used in customers via the public internet to make reservations to rent a vehicle, modify their personal account, profile etc.:

1. Customer will use a secure and standard Web Application via a Browser to access our self-service portal in the internet. We need a website to support all customer self-service related transactions.
2. Web Application Architecture must be reusable and scalable to support future updates and new feature enhancements, without a long development lifecycle.
3. For this web development, we support ***JavaScript***, ***React***, ***NodeJS*** and other standard Web Technologies. In addition, the primary Application Development Platform we use is ***C# & .NET technologies***. We have aligned ***C# & .NET*** & **Web** developers that have been assigned to assist, support, operated and update the application once NYCTech consultants complete the project and development of this system.
4. Web Portal Security Authentication System – Proper security and authentication must be implemented to make sure only the customer can access the **EZRental.com** website for his or her profile home page.

No.	Feature	Functionalities
1	**EZRental.com** Customer Web Portal	▪ Front-end WEB INTERFACE SCREENS & features used by customers via our web portal EZRentalCar.com to reserve a vehicle for rental and manage their account online. ▪ Features include: Search & reserve a car for rental, register as a new customer, search/view their account information, update their account etc.
2	**EZRental.com** Customer Web Portal Application Security Authentication System	▪ Proper security and authentication must be implemented to make sure only our customer can access the web portal to use the application.

Web Portal Application Web Pages User Interface Requirements:

The web pages graphical UI requirements are listed below:

- The GUI requirements for the web pages are like those functionalities of the Rental Agency Application that are found on the web site for example Search & reserve a car for rental, register as a new customer, search/view their account information, update their account etc.
- The design and graphics of the application should be appealing to customers and a smooth and fluent workflow.
- The following UI controls or data field need to be pre-populated in GUI Screens:

  - **Addresses**

    - Any web-page UI which contains addresses, the STATE & COUNTRY fields should be automatically populated with a list of STATES or COUNTRIES, so the user does not have to manually enter a state or a country and simply select from drop-down list etc.

  - **Discount Codes:**

    - Web pages with customer's DISCOUNT CODE fields should be a text box that allows the customer to ADD/APPLY the discount codes to redeem the coupon.

Rental Agency Application Graphical User Interface Requirements (Cont.):

- **EZPlus Rewards Codes:**

  - The EZPlus Reward web page screens with customer's EZPLUS REWARDS CODE fields should be prepopulated with the EZPlus Rewards code for the customer is being applied to. The idea is the user should be able to select the EZPLUS REWARD CODE to apply to a customer entry from a drop-down list/Combo Box etc., or be handled by the back-end database.
  - **Important:** The EZPLUS REWARDS CODE VALUES are NOT generated by a business entity in our organization, but AUTOMATICALLY GENERATED by the application on the fly when registering a new customer. The EZPlus Rewards Code values are generated by the application and available via the UI screen to be used or some other method of generation.
  - To finalize this requirement, the idea is the EZPlus Rewards Code should be automatically generated and either appear in the UI Screen or automatically generated in the database.

- **Rental Agency:**

  - Web pages that required adding a RENTAL AGENCY field should be prepopulated with the list of rental agencies in our company.

- **Vehicle Rental Category:**

  - Web pages that require the use of the VEHICLE RENTAL CATEGORY fields, must be prepopulated with the list of vehicle rental categories. Based on the business requirements, the current list of vehicle rental categories is as follows:

Vehicle Rental Category ID	*Vehicle Rental Category Name*	*Category Daily Rental Rate*
1	Car-Economic	$113.99
2	Car-Compact	$115.99
3	Car-Intermediate	$116.67
4	Car-Standard	$119.99
5	Car-Full Size	$121.99
6	Car-Premium	$127.79
7	Car-Luxury	$139.99
8	SUV-Intermediate	$127.99
9	SUV-Standard	$128.99
10	SUV-Standard Elite	$135.99
11	SUV-Full Size	$148.99
12	SUV-Premium	$157.99
13	Minivan-Standard	$152.99
14	Van-Passenger Van (12 passengers)	$161.00
15	Van-Cargo Van	$19.95
16	Pick Up-Mid Size	$69.95
17	Pick Up-Full Size	$105.99
18	Motorcycle-Touring	$19.95
19	Motorcycle-Cruiser	$199.99
20	Motorcycle-Scooter	$79.95

Application Development & Technical Requirements

- **Transport Reason:**
  - UI screens that require the use of the **Transport Reason** field must be *prepopulated* with the list of transport reasons data from **DATABASE**. Based on the business requirements, the current list of transport reasons are as follows:

Transport Reason ID	*Transport Reason Description*
1	Rental Drop off at different location
2	Vehicle Loaned to another Agency
3	Pick up from Distribution Center
4	Drop off to Distribution Center
5	Vehicle sent for maintenance
7	Unknown

  - Currently populating the database with a Transport Reason record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the transport reason data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

- **Transport Status:**
  - UI screens that require the use of the **Transport Status** field must be *prepopulated* with the list of transport status data from **DATABASE**. Based on the business requirements, the current list of transport status options are as follows:

Transport Status ID	*Transport Status Description*
1	Transport completed
2	On route to pick up location.
3	On route from pick up location
4	At pickup location. In progress (Loading etc.)
5	Pickup location delay
7	Unknown

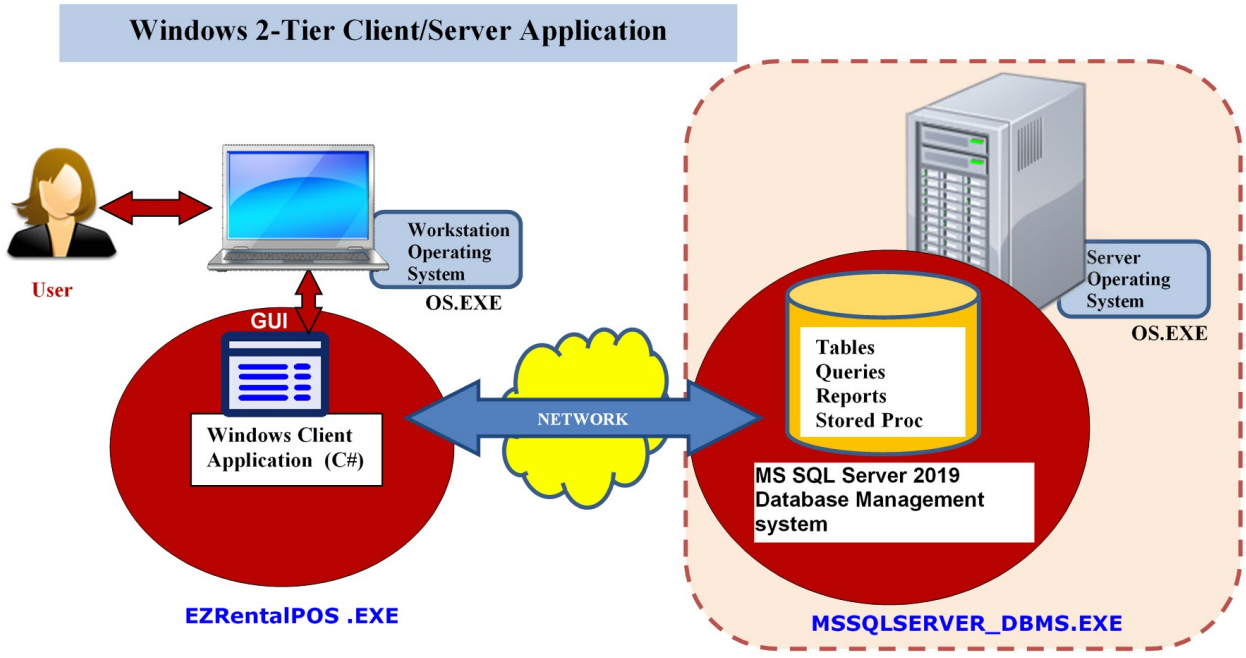
  - Currently populating the database with a transport status record is handled manually by the database administrator. In the future we would like the application to have the necessary features for our business to be able to manage the transport status data. This is not an immediate requirement out of the gate but should be targeted as part of a future upgrade.

APPLICATION PHYSICAL & TECHNICAL ARCHITECTURE

The targeted applications architecture and components for the final implemented application are the Two-Tiered Windows-Client Client/Server Application and Three-Tired Web-based Client/Server which both share a Database Tier.

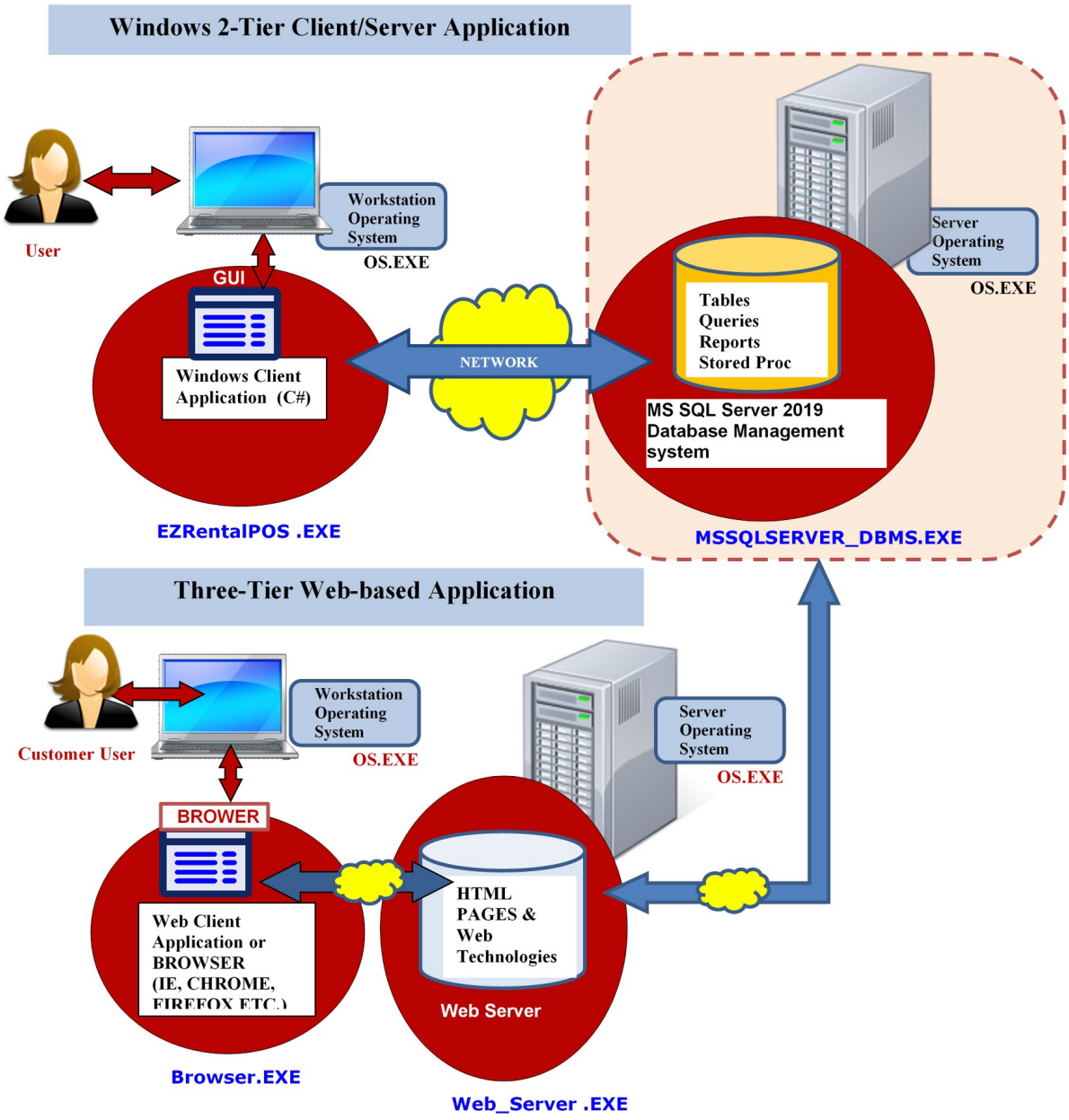
▪ **Two-Tiered Windows-Client Client/Server Application** – Front-line workers such as customer service desk in store branches, airports etc., in addition to other support personnel such as service centers employees, inventory etc., are to use this Windows-based client application for speed and performance.

Below is a pictorial diagram of this Two-Tiered Windows-Client client/server architecture used for the final software product:



▪ **Three-Tiered Web-based Client/Server** – This Web Application named EZRentalCar.com, targeted for customers who will rent a car online, in addition to the day-to-day activities of our business and office workers personnel via a Browser Application.

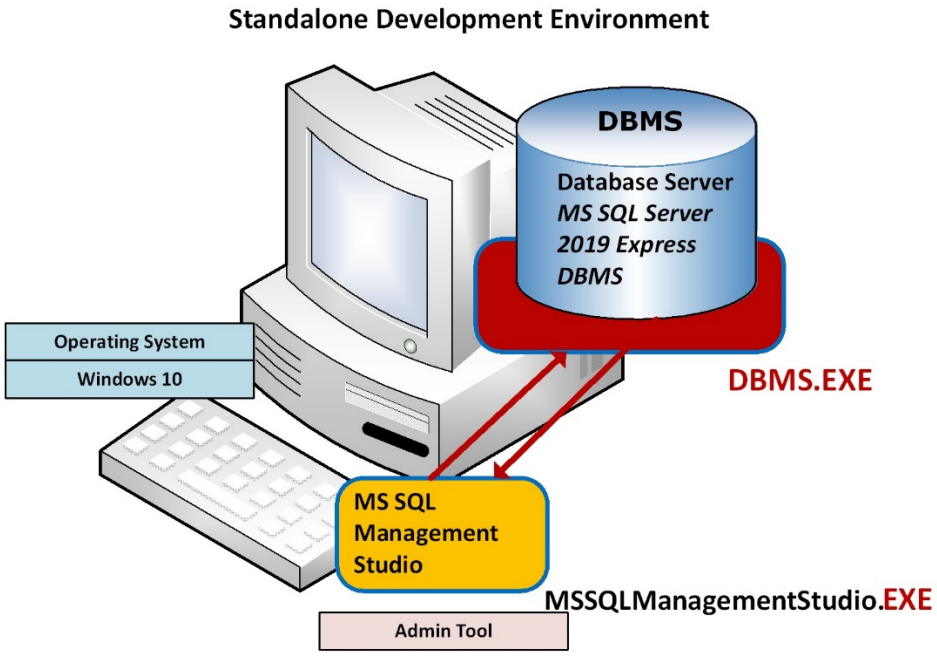
Below is a pictorial diagram of this Three-Tiered Web-based Client/Server architecture and shows both Tiers connected to the same **Database Tier** used for the final software product:



DATABASE MANAGEMENT PHYSICAL ARCHITECTURE

This section shows the planned Database Management System & Development Environment Overview. As stated before, this Database Tier will be used for both the two-tier and three- tiered architectures.

Database Tier – The Database Management System (DBMS) used is Microsoft SQL Server 2019 Express Edition since this is the standard DBMS used at EZRental Inc, along with Microsoft SQL Server Management Studio.



PROJECT MANAGEMENT METHODOLOGY

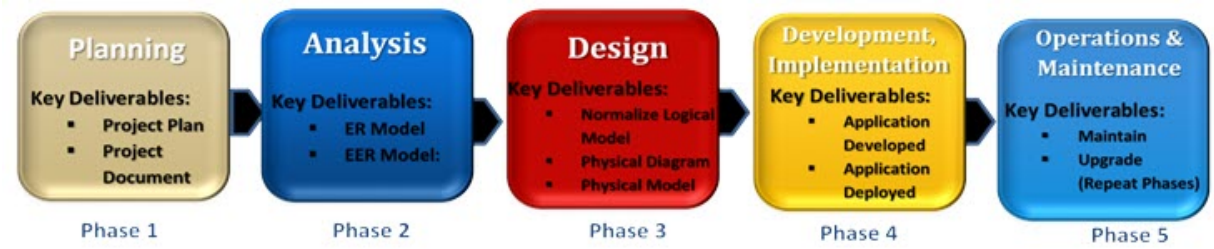
This section explains the planned project methodologies used to develop the project. A combination of the Waterfall Project Management Methodology & Agile Project Management Methodology was used for the Auto Rental Management System.

Project Management Methodology

A structured method, approach, process, technique, tools etc., to accomplish a project successfully, flexible to unexpected changes and delivered within the expected timelines.

Waterfall Methodology Phases

1. Project requirements are discussed and listed
2. Project is broken into structured method of phases.
3. Input to project first phase is the list of features (e.g., 20 features in new app business needed).
4. Each phase is executed sequentially until project completes at the expected timelines.
5. Output of project is the expected input implemented successfully (e.g., with 20 working features).

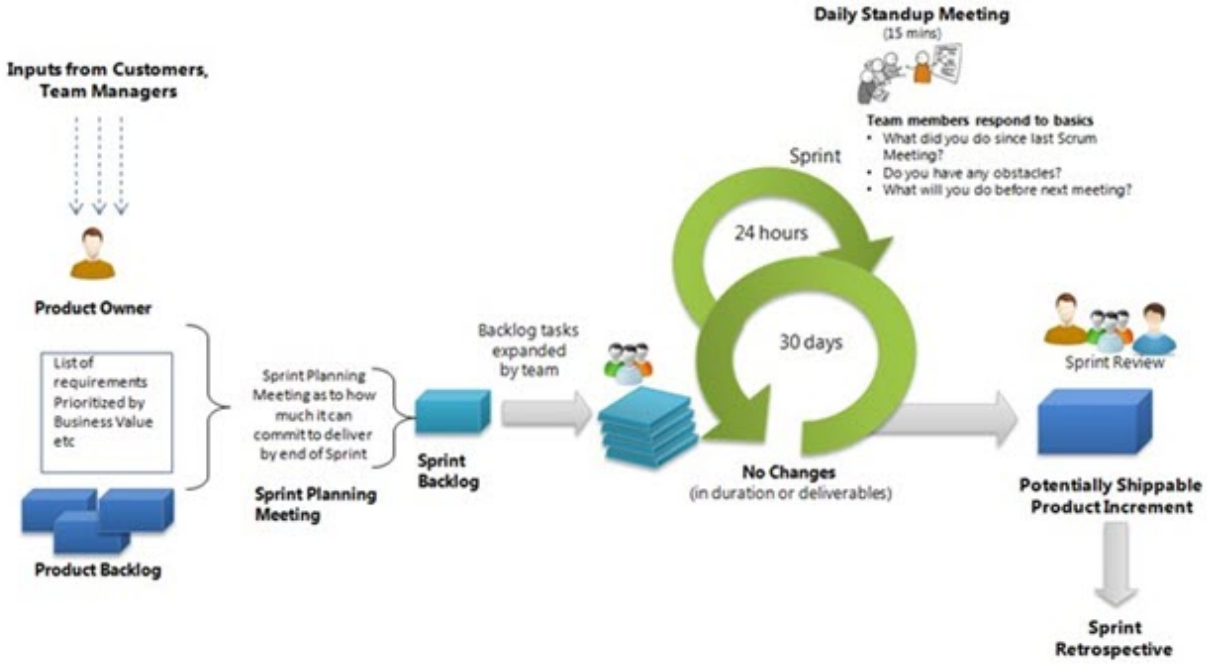


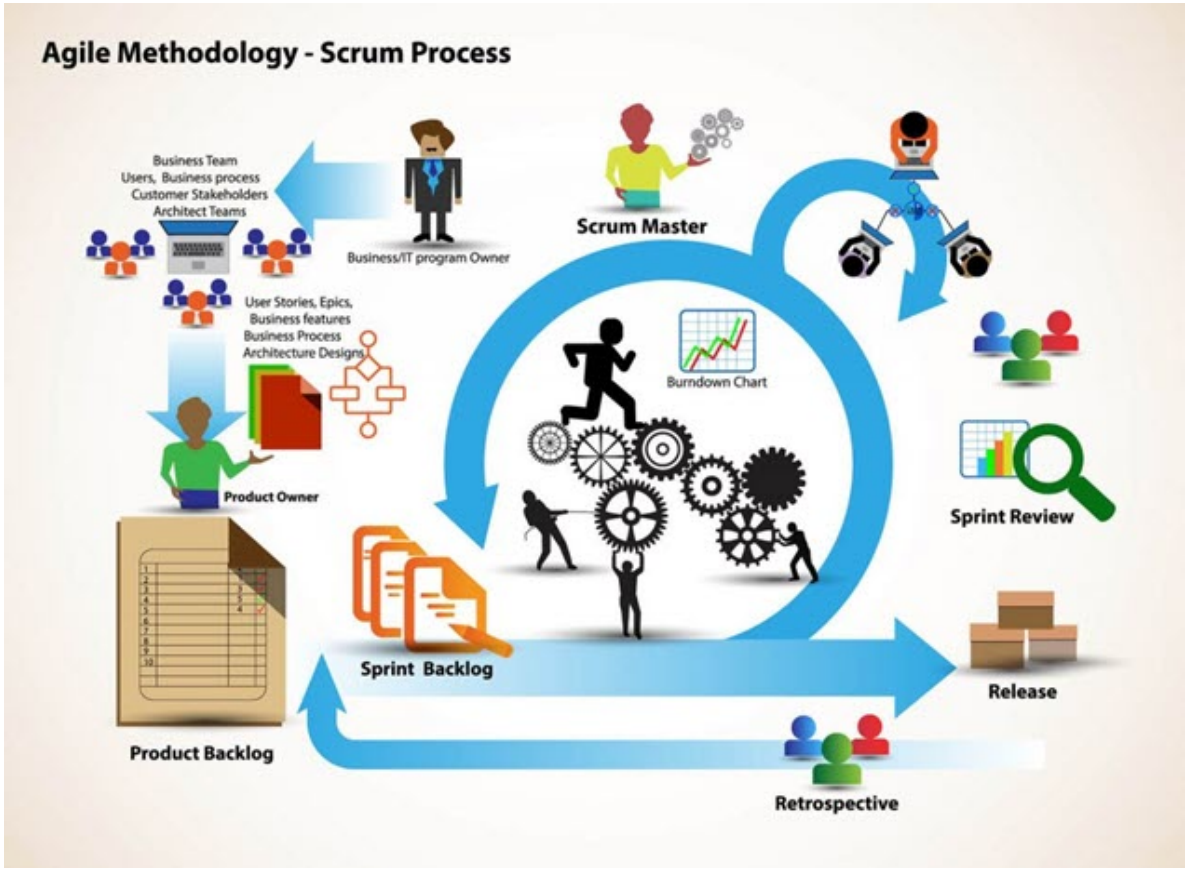
What is Agile Methodology

Agile is the evolution of Waterfall. Another Project Management Methodology that considers unexpected changes during the lifecycle of a project to ensure the project is delivered within the expected timelines.

Like the Waterfall Methodology, project requirements are discussed, listed, and broken into structured phases. Input for the project is the list of features, such as 20 features needed in the new app. This is like Waterfall but there is a strong focus on the list of features called backlog. However, the project is driven by subsets of the feature list not the entire backlog. The total list of features is divided into blocks of features to implement in increments. This is very different to Waterfall, since in Agile only subsets of the backlog or feature lists are implemented and delivered to users in increments, instead of the full list. Each phase is executed sequentially but repeated for each subset of the feature list. The repeated blocks of features are called sprints, and the output of each sprint is a subset list of features implemented and delivered to users. Only when all sprints (repetition, execution, and delivered product) and all the features in the backlog are completed within the expected timelines is the project considered finished.

Agile Scrum Methodology





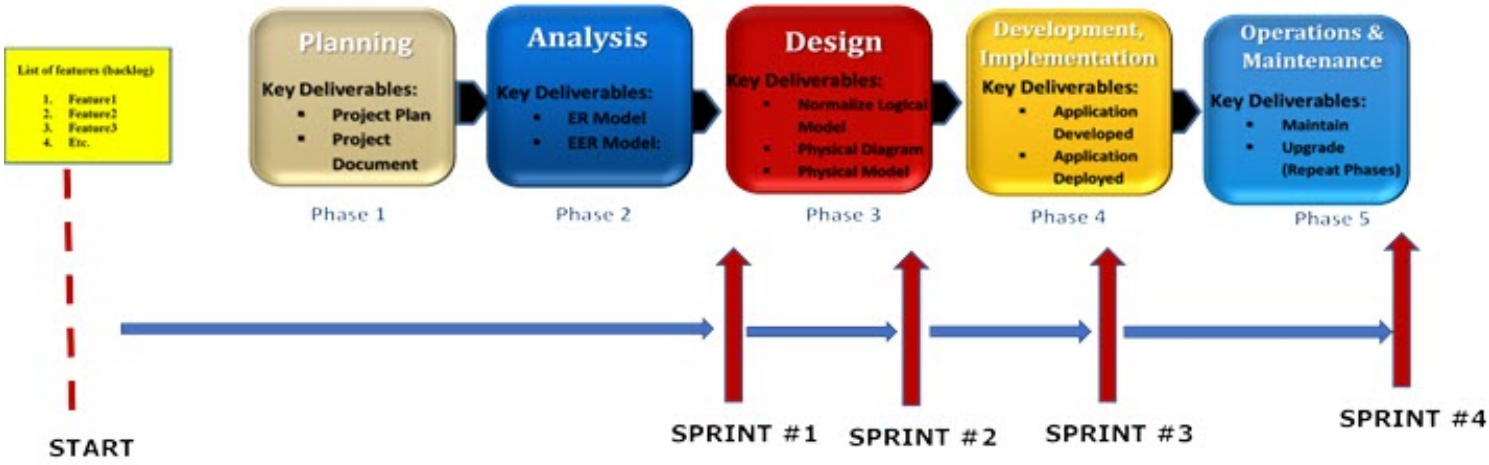
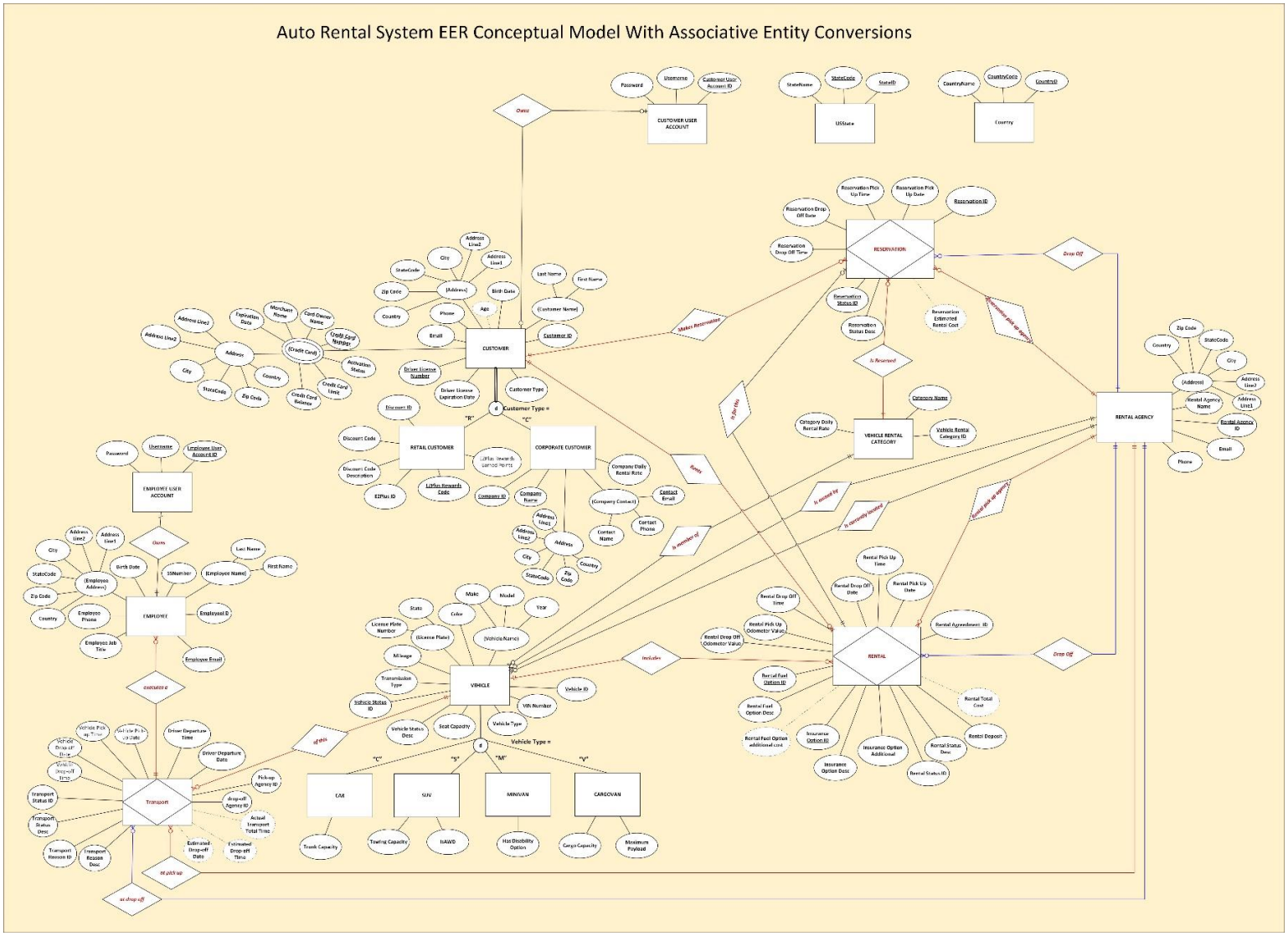


Illustration of Waterfall and Agile Methodologies used in conjunction

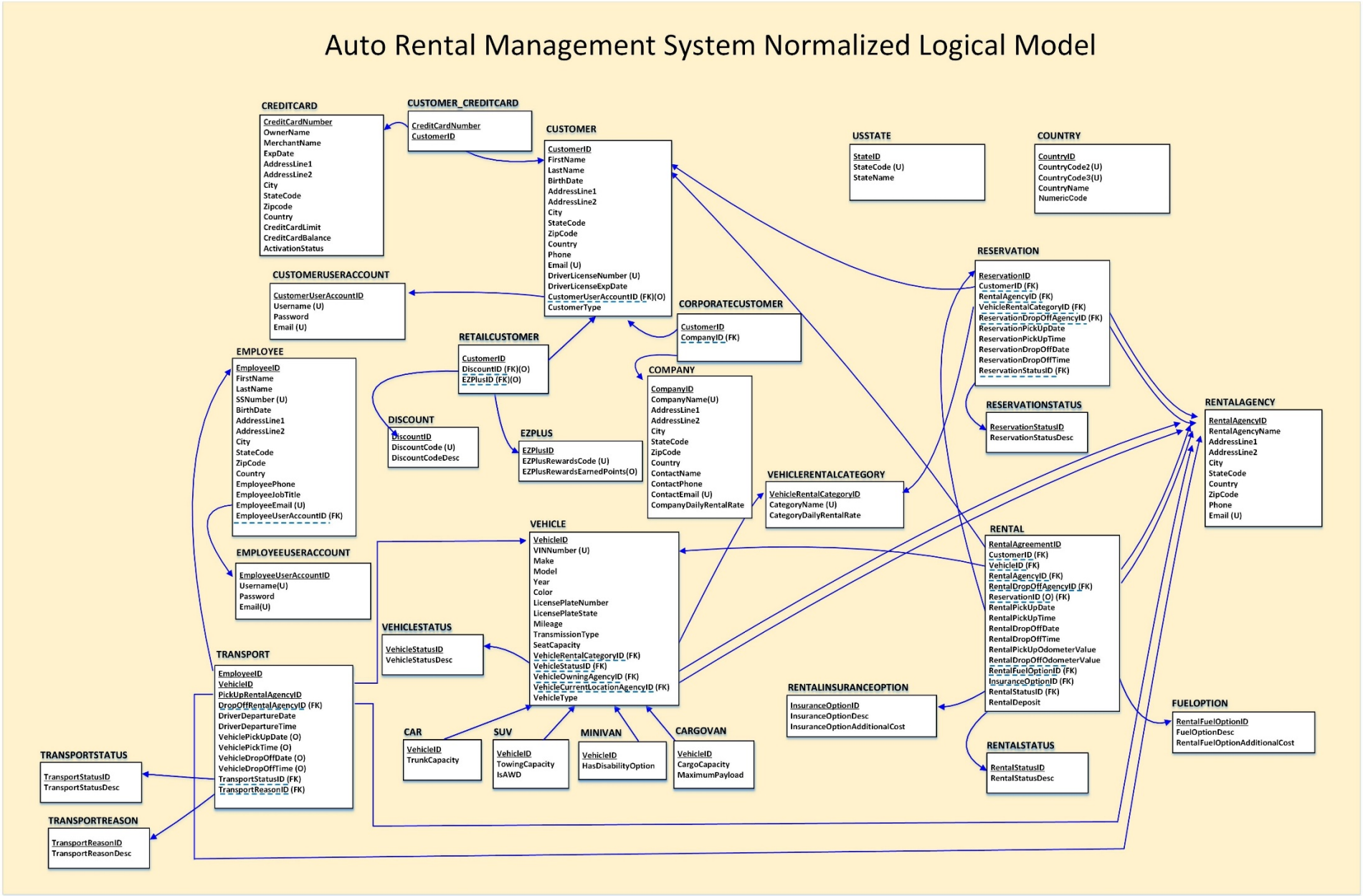
ER/EER Conceptual Model

This section shows the Extended Entity-Relationship (EER) Conceptual Model for the Auto Rental Management System. It was derived from the interview the Business Analyst gathered from the stakeholders at EZRental Inc. This model was created with all the Entities & Relationships based on the data needed in the database and how they relate to each other.



NORMALIZED LOGICAL MODEL

The normalized logical model below was derived from the EER Model. All entities are included with their relationships, attributes, primary and foreign keys.



PHYSICAL MODEL DATA DICTIONARY

The normalized logical model was used to design the Data Dictionary in this section. The dictionary presents all the metadata for each entity.

CUSTOMER						
Attribute/Column Name	**General Data Type Name**	**MS SQL Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CustomerID	Number	IDENTITY	Y	Default size of INT data type	IDENTITY PRIMARY KEY	Auto-generated Integer Identity PK starting at 11111111, no business meaning
FirstName	String	VARCHAR(50)	Y	50	NOT NULL	First name of customer
LastName	String	VARCHAR(50)	Y	50	NOT NULL	Last name of customer
BirthDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Date of Birth
AddressLine1	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 1
AddressLine2	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 2
City	String	VARCHAR(60)	Y	60	NOT NULL	City name
StateCode	Character	CHAR(2)	Y	2	NOT NULL	State code. US state only
ZipCode	String	VARCHAR(10)	Y	10	NOT NULL	US Zip Code
Country	String	VARCHAR(60)	Y	60	NOT NULL	Country name
Phone	String	VARCHAR(20)	Y	20	NOT NULL	Phone – international scope
Email (U)	String	VARCHAR(100)	Y	100	UNIQUE NOT NULL	Email address. International scope
DriverLicenseNumber (U)	String	VARCHAR(25)	Y	25	UNIQUE NOT NULL	Driver license number. International scope
DriverLicenseExpDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	US license exp date
CustomerUserAccountID (FK)(O)	String	UNIQUEIDENTIFIER	N	36	FOREIGN KEY NULL	Global Unique random number generated in the CustomerUserAccount table; FK of CustomerUserAccount table
CustomerType	Character	CHAR(1)	Y	1	NOT NULL	Value of Retail or Corporate Customer (R or C)

RETAILCUSTOMER						
Attribute/Column Name	**General Data Type Name**	**MS SQL Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CustomerID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Customer ID and PK, FK of Customer table
DiscountID (FK)(O)	Number	INT	N	Default size of INT data type	FOREIGN KEY NULL	ID of the discount, FK of Discount table
EZPlusID (FK)(O)	Number	INT	N	Default size of INT data type	FOREIGN KEY NULL	ID of EZ plus rewards, FK of EZPlus table

COPORATECUSTOMER						
Attribute/Column Name	**General Data Type Name**	**MS SQL Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CustomerID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Customer ID and PK, FK of Customer table
CompanyID (FK)	Number	INT	Y	9999999	FOREIGN KEY NOT NULL CHECK(CompanyID BETWEEN 1 AND 9999999)	Id of a company customer. FK of Company table

DISCOUNT						
Attribute/Column Name	**General Data Type Name**	**MS SQL Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
DiscountID	Number	IDENTITY	Y	Default size of INT data type	PRIMARY KEY	Auto-generated Integer Identity PK starting at 1. No business meaning
DiscountCode (U)	Character	CHAR(8)	Y	8	UNIQUE NOT NULL	Code for discount with 3 letters then 5 numbers
DiscountCodeDesc	String	VARCHAR(148)	Y	148	NOT NULL	Description of discount code

CREDITCARD						
Attribute/Column Name	**General Data Type Name**	**MS SQL Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CreditCardNumber	Character	CHAR(16)	Y	16	PRIMARY KEY	Unique identifier for a credit card instance. This PK has business meaning
OwnerName	String	VARCHAR(80)	Y	80	NOT NULL	Name of credit card owner, first + last
MerchantName	String	VARCHAR(50)	Y	50	NOT NULL	Name of merchant
ExpDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Credit card expiration date
AddressLine1	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 1
AddressLine2	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 2
City	String	VARCHAR(60)	Y	60	NOT NULL	City name
StateCode	Character	CHAR(2)	Y	2	NOT NULL	US state code only
Zipcode	String	VARCHAR(10)	Y	10	NOT NULL	US Zip Code
Country	String	VARCHAR(60)	Y	60	NOT NULL	Country column with international scope
CreditCardLimit	String	DECIMAL(9,2)	Y	X=9 Y=2	NOT NULL	CC cash limit. X = total number of digits, Y = decimal places
CreditCardBalance	String	DECIMAL(9,2)	Y	X=9 Y=2	NOT NULL	Credit card balance
ActivationStatus	Exact Numeric	BIT	Y	1	NOT NULL	Is card activated? 1 true, 0 false

COMPANY						
Attribute/Column Name	**General Data Type Name**	**MS SQL Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CompanyID	Number	INT	Y	9999999	PRIMARY KEY CHECK (CompanyID BETWEEN 1 AND 9999999)	Unique identifier for a company instance. This PK has business meaning,
CompanyName(U)	String	VARCHAR(50)	Y	50	UNIQUE NOT NULL	Name of company
AddressLine1	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 1
AddressLine2	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 2
City	String	VARCHAR(60)	Y	60	NOT NULL	City Name
StateCode	Character	CHAR(2)	Y	2	NOT NULL	US state code, only
ZipCode	String	VARCHAR(10)	Y	10	NOT NULL	US Zip Code
Country	String	VARCHAR(60)	Y	60	NOT NULL	Country
ContactName	String	VARCHAR(100)	Y	100	NOT NULL	First and last name of contact
ContactPhone	String	VARCHAR(20)	Y	20	NOT NULL	Contact Phone - international scope
ContactEmail (U)	String	VARCHAR(100)	Y	100	UNIQUE NOT NULL	Contact Email address, International scope
CompanyDailyRentalRate	Number	DECIMAL(6,2)	Y	X=6 Y=2	NOT NULL	Company daily rental rate

CUSTOMER_CREDITCARD						
Attribute/Column Name	**General Data Type Name**	**MS SQL Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CreditCardNumber	Character	CHAR(16)	Y	16	COMPOSITE PRIMARY KEY	ID of customer, composite PK combined with CustomerID, FK of credit card
CustomerID	Number	INT	Y	Default size of INT data type	COMPOSITE PRIMARY KEY	ID of customer, composite PK combined with CreditCardNumber , FK of Customer table

CUSTOMERUSERACCOUNT						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CustomerUserAccountID	String	UNIQUEIDENTIFIER	Y	GUID-Auto generated 36 characters long	PRIMARY KEY DEFAULT NEWID()	Customer user account ID, PK
Username (U)	String	VARCHAR(50)	Y	50	UNIQUE NOT NULL	Customer username
Password	String	VARCHAR(75)	Y	75	NOT NULL	Customer password
Email (U)	String	VARCHAR(100)	Y	100	Unique NOT NULL	Email address, international scope

EZPLUS						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
EZPlusID	Number	IDENTITY	Y	Default size of INT data type	PRIMARY KEY	Auto-generated Integer Identity PK starting at 1, no business meaning
EZPlusRewardsCode (U)	Character	CHAR(8)	Y	8	UNIQUE NOT NULL	Code for EZplus Rewards with 3 letters then 5 numbers
EZPlusRewardsEarnedPoints(O)	Number	INT	N	Default size of INT data type	NULL	Number of points rewarded per code

VEHICLESTATUS						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
VehicleStatusID	Number	TINYINT	Y	9	PRIMARY KEY CHECK (VehicleStatusID BETWEEN 1 AND 9)	Unique identifier for a company instance. This PK has business meaning,
VehicleStatusDesc	String	VARCHAR(40)	Y	40	NOT NULL	Description of vehicle status

VEHICLE						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
VehicleID	Number	IDENTITY	Y	Default size of INT data type	PRIMARY KEY	Auto-generated Integer Identity PK starting at 111111, no business meaning
VINNumber (U)	Character	CHAR(17)	Y	17	UNIQUE NOT NULL	Unique vehicle Identification Number
Make	String	VARCHAR(40)	Y	40	NOT NULL	Make of vehicle
Model	String	VARCHAR(40)	Y	40	NOT NULL	Model of vehicle
Year	Number	SMALLINT	Y	Default size SMALLINT	NOT NULL	Year of vehicle
Color	String	VARCHAR(27)	Y	27	NOT NULL	Color of vehicle
LicensePlateNumber	String	VARCHAR(15)	Y	15	NOT NULL	US License plate number
LicensePlateState	Character	CHAR(2)	Y	2	NOT NULL	Plate issued - US state name only
Mileage	Number	INT	Y	300000	NOT NULL CHECK (Mileage BETWEEN 1 AND 300000)	Total vehicle mileage
TransmissionType	String	VARCHAR(50)	Y	50	NOT NULL	Vehicle transmission type
SeatCapacity	Number	TINYINT	Y	Default size TINYINT	NOT NULL	Vehicle seat capacity
VehicleRentalCategoryID (FK)	Number	TINYINT	Y	25	FOREIGN KEY NOT NULL CHECK(VehicleRentalCategoryID BETWEEN 1 AND 25)	Id of vehicle category, FK of VehicleRentalCategory table
VehicleStatusID (FK)	Number	TINYINT	Y	9	FOREIGN KEY NOT NULL CHECK(VehicleStatusID BETWEEN 1 AND 9)	Id of vehicle status, FK of VehicleStatus table
VehicleOwningAgencyID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Id of rental agency that owns vehicle, FK of Rental Agency table
VehicleCurrentLocation AgencyID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Id of agency that currently has vehicle, FK of RentalAgency table
VehicleType	Character	CHAR(1)	Y	1	NOT NULL	Vehicle type Value = C, S, M, or V

VEHICLERENTALCATEGORY						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
VehicleRentalCategoryID	Number	TINYINT	Y	25	PRIMARY KEY CHECK (VehicleRentalCategory BETWEEN 1 AND 25)	Unique identifier for a vehicle rental category instance. This PK has business meaning
CategoryName (U)	String	VARCHAR (40)	Y	40	UNIQUE NOT NULL	Name of the vehicle rental category
CategoryDailyRentalRate	Number	DECIMAL (5,2)	Y	X=5 Y=2	NOT NULL	Vehicle category daily rental rate. Maximum rate currently of 199.99

MINIVAN						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
VehicleID (FK)	Number	INT	Y	Default size of INT	PRIMARY KEY	Id of vehicle, FK of Vehicle table
HasDisabilityOption	Number	BIT	Y	1	NOT NULL	Does Van offer disability option? 1 or 0

CAR						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
VehicleID (FK)	Number	INT	Y	Default size of INT	PRIMARY KEY	Id of vehicle, FK of Vehicle table
TrunkCapacity	Number	Decimal (4,1)	Y	X=4 Y=1	NOT NULL	Capacity in cubic ft.

SUV						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
VehicleID (FK)	Number	INT	Y	Default size of INT	PRIMARY KEY	Id of vehicle, FK of Vehicle table
TowingCapacity	Number	SMALLINT	Y	Default size SMALLINT	NOT NULL	Towing Capacity in lbs.
IsAWD	Number	BIT	Y	1	NOT NULL	Is Vehicle All wheel Drive? 1 or 0

CARGOVAN						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
VehicleID (FK)	Number	INT	Y	Default size of INT	PRIMARY KEY	Id of vehicle, FK of Vehicle table
CargoCapacity	Number	DECIMAL (4,1)	Y	X=4 Y=1	NOT NULL	Cargo capacity in cubic ft.
MaximumPayload	Number	SMALLINT	Y	Default size SMALLINT	NOT NULL	Maximum Payload in lbs.

RESERVATION						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
ReservationID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Unique identifier for a reservation instance. This PK has business meaning,
CustomerID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Customer Id, FK of Customer table
RentalAgencyID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Rental Agency ID, FK of Rental Agency
VehicleRentalCategoryID (FK)	Number	TINYINT	Y	25	FOREIGN KEY NOT NULL CHECK(VehicleRentalCategoryID BETWEEN 1 AND 25)	Id of Vehicle Rental Category, FK of VehicleRentalCategory table
ReservationDropOffAgencyID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Id of agency where vehicle reserved will be dropped off, FK of RentalAgency table
ReservationPickUplDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Reservation pick up date
ReservationPickUpTime	Number	INT	Y	2400	NOT NULL CHECK (ReservationPickUpTime BETWEEN 0000 AND 2400)	Pick up time of reservation, military time format.
ReservationDropOffDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Reservation drop off date
ReservationDropOffTime	Number	INT	Y	2400	NOT NULL CHECK (Reservation-DropOffTime BETWEEN 0000 AND 2400)	Reservation drop off time, military time format
ReservationStatusID (FK)	Number	TINYINT	Y	9	FOREIGN KEY NOT NULL CHECK(ReservationStatusID BETWEEN 1 AND 9)	Reservation status ID, FK of ReservationStatus table)

RENTAL						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
RentalAgreementID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Unique identifier for a rental instance. This PK has business meaning
CustomerID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Customer Id FK of Customer table
VehicleID (FK)	Number	INT	Y	Default size of INT	FOREIGN KEY NOT NULL	Id of vehicle FK of Vehicle table
RentalAgencyID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Id of rental agency, FK of RentalAgency table
RentalDropOffAgencyID (FK)	Number	INT	Y	Default size of INT data type	FOREIGN KEY NOT NULL	Agency ID where vehicle rented will be dropped off, FK of RentalAgency table
ReservationID (O) (FK)	Number	INT	N	Default size of INT data type	FOREIGN KEY NULL	Reservation ID, FK of Reservation table
RentalPickUpDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Rental pick up date
RentalPickUpTime	Number	INT	Y	2400	NOT NULL CHECK (Rental-PickUpTime BETWEEN 0000 AND 2400)	Pick Up time of rental, military time format
RentalDropOffDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Rental drop off date
RentalDropOffTime	Number	INT	Y	2400	NOT NULL CHECK (Rental-DropOffTime BETWEEN 0000 AND 2400)	Rental drop off time, military time format
RentalPickUpOdometerValue	Number	INT	Y	300000	NOT NULL CHECK (RentalPickUp OdometerValue BETWEEN 0 AND 300000)	Odometer value upon rental pick up
RentalDropOffOdometerValue	Number	INT	Y	300000	NOT NULL (RentalDropOff OdometerValue BETWEEN 0 AND 300000)	Odometer value upon rental drop off
RentalFuelOptionID (FK)	Number	TINYINT	Y	5	FOREIGN KEY NOT NULL CHECK (RentaFuelOptionID BETWEEN 1 AND 5)	Id of rental fuel option. (Foreign key of FuelOption)
InsuranceOptionID (FK)	Number	TINYINT	Y	8	FOREIGN KEY NOT NULL CHECK(InsuranceOptionID BETWEEN 1 AND 8)	Id of insurance option. (Foreign key of RentalInsurance Option table)
RentalStatusID (FK)	Number	TINYINT	Y	10	FOREIGN KEY NOT NULL CHECK(RentalStatusID BETWEEN 1 AND 10)	Id of rental status. FK of RentalStatus table
RentalDeposit	Number	DECIMAL (7,2)	Y	X=7 Y=2	NOT NULL	Deposit amount. Rental period + 25% of the rental

RESERVATIONSTATUS						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
ReservationStatusID	Number	TINYINT	Y	9	PRIMARY KEY CHECK (ReservationStatusID BETWEEN 1 AND 9)	Unique identifier for a reservation status instance. This PK has business meaning
ReservationStatusDesc	String	VARCHAR(30)	Y	30	NOT NULL	Description of reservation status

RENTALINSURANCEOPTION						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
InsuranceOptionID	Number	TINYINT	Y	8	PRIMARY KEY CHECK (InsuranceOptionID BETWEEN 1 AND 8)	Unique identifier for an insurance option instance. This PK has business meaning
InsuranceOptionDesc	String	VARCHAR (MAX)	Y	Default MAX size	NOT NULL	Rental insurance option description
InsuranceOptionAdditionalCost	Number	DECIMAL (5,2)	Y	X=5 Y=2	NOT NULL	Rental insurance cost per day

RENTALSTATUS						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
RentalStatusID	Number	TINYINT	Y	10	Primary Key CHECK (RentalStatusID BETWEEN 1 AND 10)	The ID number of the rental status. This PK has business meaning
RentalStatusDesc	String	VARCHAR(40)	Y	40	NOT NULL	Description of rental status

FUELOPTION						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
RentalFuelOptionID	Number	TINYINT	Y	5	PRIMARY KEY CHECK (RentaFuel OptionID BETWEEN 1 AND 5)	The ID number of rental fuel option. This primary key has business meaning
FuelOptionDesc	String	VARCHAR (95)	Y	95	NOT NULL	Description of fuel option
RentalFuelOptionAdditionalCost	String	VARCHAR (105)	Y	105	NOT NULL	Additional fuel cost calculation description

EMPLOYEEUSERACCOUNT						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
EmployeeUserAccountID	Character	CHAR(36)	Y	36	PRIMARY KEY	Global Unique random number generated in the Back-end application, PK has no business meaning
Username (U)	String	VARCHAR (50)	Y	50	UNIQUE NOT NULL	Customer username
Password	String	VARCHAR (75)	Y	75	NOT NULL	Customer password
Email (U)	String	VARCHAR (100)	Y	100	UNIQUE NOT NULL	Email address. International scope

EMPLOYEE						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
EmployeeID	Number	IDENTITY	Y	Default size of INT	PRIMARY KEY	Auto-generated Integer Identity primary key starting at 1111111, no business meaning
FirstName	String	VARCHAR(50)	Y	50	NOT NULL	First name of employee
LastName	String	VARCHAR(50)	Y	50	NOT NULL	Last name of employee
SSNumber(U)	Character	CHAR(11)	Y	11	UNIQUE NOT NULL	Unique SSI of employee
BirthDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Date of Birth
AddressLine1	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 1
AddressLine2	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 2
City	String	VARCHAR(60)	Y	60	NOT NULL	City name
StateCode	Character	CHAR(2)	Y	2	NOT NULL	State code. US state only
ZipCode	String	VARCHAR(10)	Y	10	NOT NULL	US Zip Code
Country	String	VARCHAR(60)	Y	60	NOT NULL	Country column with international scope
EmployeePhone	String	VARCHAR(20)	Y	20	NOT NULL	Employee Phone – international scope
EmployeeJobTitle	String	VARCHAR(90)	Y	90	NOT NULL	Employee job title
EmployeeEmail (U)	String	VARCHAR(100)	Y	100	UNIQUE NOT NULL	Employee Email address. International scope
EmployeeUserAccountID (FK)	Character	CHAR(36)	Y	36	FOREIGN KEY NOT NULL	Employee user account ID, FK of EmployeeUserAccount table

RENTALAGENCY						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
RentalAgencyID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Unique identifier for a rental agency instance. This PK has business meaning
RentalAgencyName	String	VARCHAR(100)	Y	100	NOT NULL	Rental Agency Name, first and last
AddressLine1	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 1
AddressLine2	String	VARCHAR(50)	Y	50	NOT NULL	House number & street part 2
City	String	VARCHAR(60)	Y	60	NOT NULL	City Name
StateCode	Character	CHAR(2)	Y	2	NOT NULL	US state code, only
Country	String	VARCHAR(60)	Y	60	NOT NULL	Country column with international scope
ZipCode	String	VARCHAR(10)	Y	10	NOT NULL	US Zip Code
Phone	String	VARCHAR(20)	Y	20	NOT NULL	Agency Phone – international scope
Email (U)	String	VARCHAR(100)	Y	100	UNIQUE NOT NULL	Agency Email address. International scope

TRANSPORTSTATUS						
Attribute/Column Name	**General Data Type Name**	**MS SQL Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
TransportStatusID	Number	TINYINT	Y	9	PRIMARY KEY CHECK (TransportStatusID BETWEEN 1 AND 9)	Transport Status ID
TransportStatusDesc	String	VARCHAR(80)	Y	80	NOT NULL	Transport status description

TRANSPORTREASON						
Attribute/Column Name	**General Data Type Name**	**MS SQL Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
TransportReasonID	Number	TINYINT	Y	9	PRIMARY KEY CHECK (TransportReasonID BETWEEN 1 AND 9)	Transport reason ID
TransportReasonDesc	String	VARCHAR(80)	Y	80	NOT NULL	Transport reason description

TRANSPORT						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
EmployeeID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Employee ID, composite key, FK of Employee table
VehicleID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Vehicle ID, composite key, FK of Vehicle table
PickUpRentalAgencyID	Number	INT	Y	Default size of INT data type	PRIMARY KEY	Pick up rental agency ID, composite key, FK of RentalAgency table
DropOffRentalAgencyID (FK)	Number	INT	Y	Default size of INT data type	NOT NULL	Drop off rental agency ID, FK of RentalAgency table
DriverDepartureDate	Date	DATE	Y	MM/DD/YYYY	NOT NULL	Driver departure date
DriverDepartureTime	Number	SMALLINT	Y	2400	NOT NULL CHECK (DriverDepartureTime BETWEEN 0000 AND 2400)	Driver departure time, military time format
VehiclePickUpDate (O)	Date	DATE	N	MM/DD/YYYY	NULL	Vehicle pick up date
VehiclePickUpTime (O)	Number	SMALLINT	N	2400	NULL CHECK (DriverDepartureTime BETWEEN 0000 AND 2400)	Vehicle pick up time, military time format
VehicleDropOffDate (O)	Date	DATE	N	MM/DD/YYYY	NULL	Vehicle drop off date
VehicleDropOffTime (O)	Number	SMALLINT	N	2400	NULL CHECK (DriverDepartureTime BETWEEN 0000 AND 2400)	Vehicle drop off time, military time format
TransportStatusID (FK)	Number	TINYINT	Y	9	NOT NULL CHECK (TransportStatusID BETWEEN 1 AND 9)	Transport Status ID, FK of TransportStatus table
TransportReasonID (FK)	Number	TINYINT	Y	9	NOT NULL CHECK (TransportReasonID BETWEEN 1 AND 9)	Transport reason ID, FK of TransportReason table

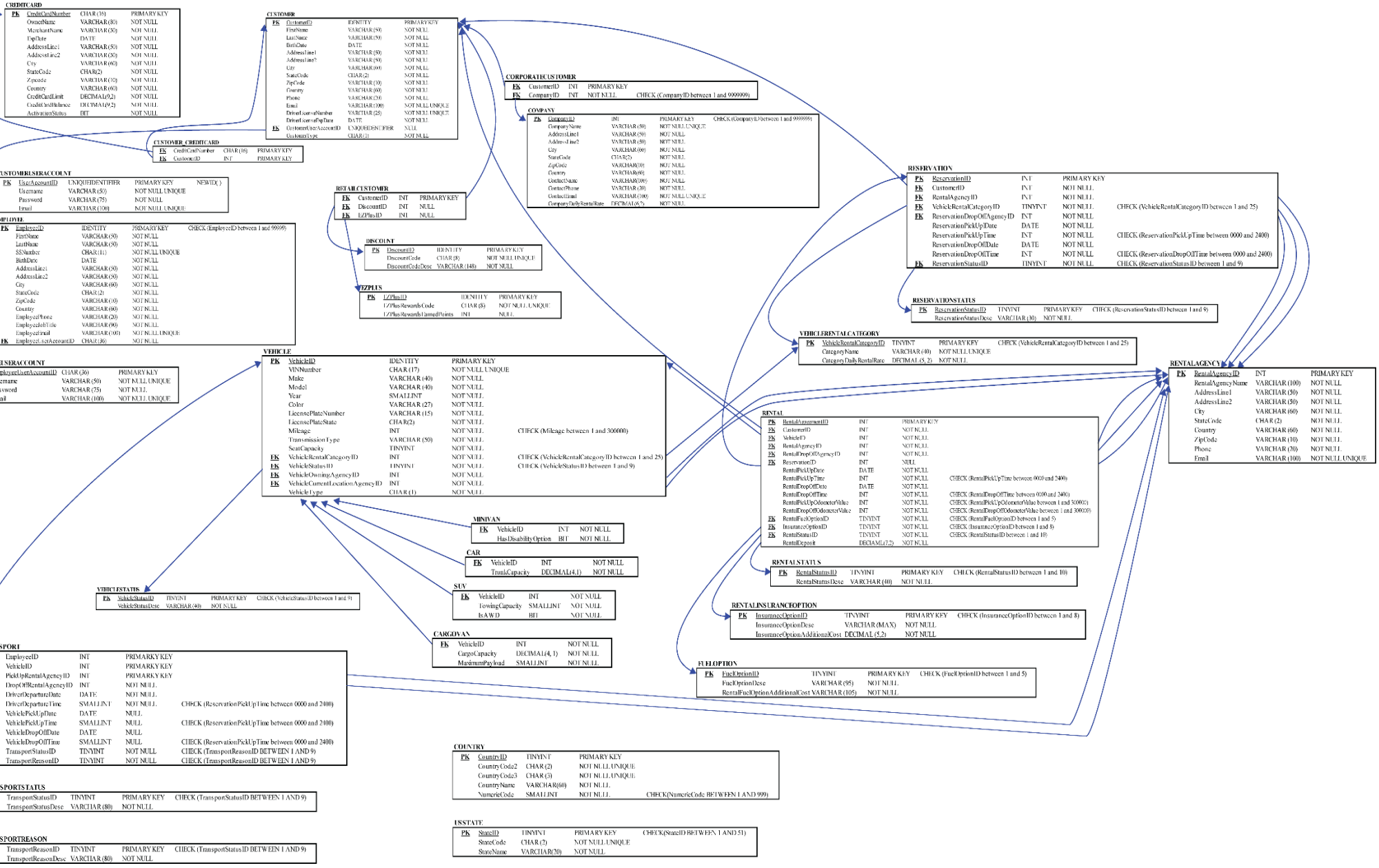
COUNTRY						
Attribute/Column Name	**General Data Type Name**	**Oracle Data Type**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
CountryID	Number	TINYINT	Y	Default size of TINYINT	PRIMARY KEY	The ID number of a country. This primary key has business meaning.
CountryCode2 (U)	Character	CHAR(2)	Y	2	UNIQUE NOT NULL	Country code 2
CountryCode3 (U)	Character	CHAR(3)	Y	3	UNIQUE NOT NULL	Country code 3
CountryName	String	VARCHAR(60)	Y	60	NOT NULL	Country name
NumericCode	Number	SMALLINT	Y	999	NOT NULL CHECK(NumericCode BETWEEN 1 AND 999)	Country numeric code

USSTATE						
Attribute/Column Name	**General Data Type Name**	**MS SQL Type Name**	**Is it Required?**	**Length/Size /Format**	**Constraints**	**Description/ purpose**
StateID	Number	TINYINT	Y	51	PRIMARY KEY CHECK (StateID BETWEEN 1 AND 51)	The ID number of a US state. This primary key has business meaning.
StateCode (U)	Character	CHAR(2)	Y	2	UNIQUE NOT NULL	Unique US state code
StateName	String	VARCHAR (20)	Y	20	NOT NULL	US state name only

PHYSICAL MODEL SCHEMA DIAGRAM

The Physical Model is a combination of both the Normalized Logical Model and the Data Dictionary.

AUTO RENTAL PHYSICAL MODEL SCHEMA DIAGRAM



DEVELOPMENT & IMPLEMENTATION

Using the physical model schema diagram, the script below was created, which contains all the data definition language (DDL) statements required to create the database and its entities. As previously stead, Microsoft SQL Express and Microsoft SQL Management Studio were used to create this script.

```
--CREATE THE DATABASE
CREATE DATABASE EZRentalDB;

--SET DEFAULT DATABASE TO USE
use EZRentalDB;

--CREATE CREDITCARD TABLE
CREATE TABLE CreditCard
(
    CreditCardNumber    CHAR(16)        PRIMARY KEY,
    OwnerName           VARCHAR(80)     NOT NULL,
    MerchantName        VARCHAR(50)     NOT NULL,
    ExpDate             DATE            NOT NULL,
    AddressLine1        VARCHAR(50)     NOT NULL,
    AddressLine2        VARCHAR(50)     NOT NULL,
    City                VARCHAR(40)     NOT NULL,
    StateCode           CHAR(2)         NOT NULL,
    ZipCode             VARCHAR(10)     NOT NULL,
    Country             VARCHAR(60)     NOT NULL,
    CreditCardLimit     DECIMAL(9,2)    NOT NULL,
    CreditCardBalance   DECIMAL(9,2)    NOT NULL,
    ActivationStatus    BIT             NOT NULL
);


--CREATE EMPLOYEE USER ACCOUNT TABLE
CREATE TABLE EmployeeUserAccount
(
    EmployeeUserAccountID   CHAR(36)        PRIMARY KEY,
    Username                VARCHAR(50)     UNIQUE NOT NULL,
    Password                VARCHAR(75)     NOT NULL,
    Email                   VARCHAR(100)    UNIQUE NOT NULL
);

--CREATE EMPLOYEE TABLE
CREATE TABLE Employee
(
    EmployeeID              INT IDENTITY(1111111,1) PRIMARY KEY NOT NULL,
    FirstName               VARCHAR(50)             NOT NULL,
    LastName                VARCHAR(50)             NOT NULL,
    SSNumber                CHAR(11)                UNIQUE NOT NULL,
    BirthDate               DATE                    NOT NULL,
    AddressLine1            VARCHAR(50)             NOT NULL,
    AddressLine2            VARCHAR(50)             NOT NULL,
```

```
    City                    VARCHAR(60)             NOT NULL,
    StateCode               CHAR(2)                 NOT NULL,
    ZipCode                 VARCHAR(10)             NOT NULL,
    Country                 VARCHAR(60)             NOT NULL,
    EmployeePhone           VARCHAR(20)             NOT NULL,
    EmployeeJobTitle        VARCHAR(90)             NOT NULL,
    EmployeeEmail           VARCHAR(100)            UNIQUE NOT NULL,
    EmployeeUserAccountID   CHAR(36)                NOT NULL,

    CONSTRAINT fk_EmployeeUserAccountID_Employee
    FOREIGN KEY (EmployeeUserAccountID)
    REFERENCES EmployeeUserAccount(EmployeeUserAccountID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE CUSTOMER USER ACCOUNT TABLE
CREATE TABLE CustomerUserAccount
(
    CustomerUserAccountID   UNIQUEIDENTIFIER    PRIMARY KEY DEFAULT NEWID(),
    Username                VARCHAR(50)         UNIQUE NOT NULL,
    Password                VARCHAR(75)         NOT NULL,
    Email                   VARCHAR(100)        UNIQUE NOT NULL
);

--CREATE CUSTOMER TABLE
CREATE TABLE Customer
(
    CustomerID              INT IDENTITY(11111111,1)    PRIMARY KEY NOT NULL,
    FirstName               VARCHAR(50)                 NOT NULL,
    LastName                VARCHAR(50)                 NOT NULL,
    BirthDate               DATE                        NOT NULL,
    AddressLine1            VARCHAR(50)                 NOT NULL,
    AddressLine2            VARCHAR(50)                 NOT NULL,
    City                    VARCHAR(60)                 NOT NULL,
    StateCode               CHAR(2)                     NOT NULL,
    ZipCode                 VARCHAR(10)                 NOT NULL,
    Country                 VARCHAR(60)                 NOT NULL,
    Phone                   VARCHAR(20)                 NOT NULL,
    Email                   VARCHAR(100)                UNIQUE NOT NULL,
    DriverLicenseNumber     VARCHAR(25)                 UNIQUE NOT NULL,
    DriverLicenseExpDate    DATE                        NOT NULL,
    CustomerUserAccountID   UNIQUEIDENTIFIER                    NULL,
    CustomerType            CHAR(1)                     NOT NULL,

    CONSTRAINT fk_CustomerUserAccountID_Customer
    FOREIGN KEY (CustomerUserAccountID)
    REFERENCES CustomerUserAccount(CustomerUserAccountID)
);

--CREATE CUSTOMER_CREDITCARD TABLE
CREATE TABLE Customer_CreditCard
(
    CreditCardNumber    CHAR(16)    NOT NULL,
    CustomerID          INT         NOT NULL,

    CONSTRAINT pk_Customer_CreditCard
    PRIMARY KEY (CreditCardNumber, CustomerID),

    CONSTRAINT fk_CCNumber_CustomerCC
```

```
    FOREIGN KEY (CreditCardNumber)
    REFERENCES CreditCard(CreditCardNumber)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_CustomerID_CustomerCC
    FOREIGN KEY (CustomerID)
    REFERENCES Customer(CustomerID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE DISCOUNT TABLE
CREATE TABLE Discount
(
    DiscountID          INT IDENTITY    PRIMARY KEY,
    DiscountCode        CHAR(8)         UNIQUE NOT NULL,
    DiscountCodeDesc    VARCHAR(148)    NOT NULL
);

--CREATE EZPLUS TABLE
CREATE TABLE EZPlus
(
    EZPlusID            INT IDENTITY    PRIMARY KEY,
    EZPlusRewardsCode   CHAR(8)         UNIQUE NOT NULL,
    EZPlusEarnedPoints  INT             NULL
);

--CREATE RETAIL CUSTOMER TABLE
CREATE TABLE RetailCustomer
(
    CustomerID  INT     PRIMARY KEY,
    DiscountID  INT     NULL,
    EZPlusID    INT     NULL,

    CONSTRAINT fk_CustomerID_RetailCustomer
    FOREIGN KEY (CustomerID)
    REFERENCES Customer(CustomerID)
    ON DELETE CASCADE ON UPDATE CASCADE,


    CONSTRAINT fk_DiscountID_RetailCustomer
    FOREIGN KEY (DiscountID)
    REFERENCES Discount(DiscountID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_EZPlusID_RetailCustomer
    FOREIGN KEY (EZPlusID)
    REFERENCES EZPlus(EZPlusID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE COMPANY TABLE
CREATE TABLE Company
(
    CompanyID               INT             PRIMARY KEY CHECK(CompanyID
BETWEEN 1 AND 9999999),
    CompanyName             VARCHAR(50)     UNIQUE NOT NULL,
    AddressLine1            VARCHAR(50)     NOT NULL,
    AddressLine2            VARCHAR(50)     NOT NULL,
    City                    VARCHAR(60)     NOT NULL,
```

```
    StateCode               CHAR(2)          NOT NULL,
    ZipCode                 VARCHAR(10)      NOT NULL,
    Country                 VARCHAR(60)      NOT NULL,
    ContactName             VARCHAR(100)     NOT NULL,
    ContactPhone            VARCHAR(20)      NOT NULL,
    ContactEmail            VARCHAR(100)     UNIQUE NOT NULL,
    CompanyDailyRentalRate  DECIMAL(6,2)     NOT NULL,
);


--CREATE CORPORATE CUSTOMER TABLE
CREATE TABLE CorporateCustomer
(
    CustomerID      INT     PRIMARY KEY,
    CompanyID       INT     NOT NULL,

    CONSTRAINT  fk_CustomerID_CorporateCustomer
    FOREIGN KEY (CustomerID)
    REFERENCES Customer(CustomerID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT  fk_CompanyID_CorporateCustomer
    FOREIGN KEY (CompanyID)
    REFERENCES Company(CompanyID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE VEHICLE STATUS TABLE
CREATE TABLE VehicleStatus
(
    VehicleStatusID     TINYINT     PRIMARY KEY CHECK(VehicleStatusID BETWEEN
1 AND 9),
    VehicleStatusDesc   VARCHAR(40) NOT NULL
);

--CREATE VEHICLE RENTAL CATEGORY
CREATE TABLE VehicleRentalCategory
(
    VehicleRentalCategoryID     TINYINT         PRIMARY KEY
CHECK(VehicleRentalCategoryID BETWEEN 1 AND 25),
    CategoryName                VARCHAR(40)     UNIQUE NOT NULL,
    CategoryDailyRentalRate     DECIMAL(5,2)    NOT NULL
);

--CREATE RENTAL AGENCY TABLE
CREATE TABLE RentalAgency
(
    RentalAgencyID      INT             PRIMARY KEY,
    RentalAgencyName    VARCHAR(100)    NOT NULL,
    AddressLine1        VARCHAR(50)     NOT NULL,
    AddressLine2        VARCHAR(50)     NOT NULL,
    City                VARCHAR(60)     NOT NULL,
    StateCode           CHAR(2)         NOT NULL,
    Country             VARCHAR(60)     NOT NULL,
    ZipCode             VARCHAR(10)     NOT NULL,
    Phone               VARCHAR(20)     NOT NULL,
    Email               VARCHAR(100)    UNIQUE NOT NULL
);
```

```
--CREATE RENTAL INSURANCE OPTION TABLE
CREATE TABLE RentalInsuranceOption
(
    InsuranceOptionID               TINYINT         PRIMARY KEY
CHECK(InsuranceOptionID BETWEEN 1 AND 8),
    InsuranceOptionDesc             VARCHAR(MAX)    NOT NULL,
    InsuranceOptionAdditionalCost   DECIMAL(5,2)    NOT NULL
);

--CREATE RENTAL STATUS TABLE
CREATE TABLE RentalStatus
(
    RentalStatusID      TINYINT         PRIMARY KEY CHECK(RentalStatusID
BETWEEN 1 AND 10),
    RentalStatusDesc    VARCHAR(40)     NOT NULL
);

--CREATE FUEL OPTION TABLE
CREATE TABLE FuelOption
(
    RentalFuelOptionID              TINYINT         PRIMARY KEY
CHECK(RentalFuelOptionID BETWEEN 1 AND 5),
    FuelOptionDesc                  VARCHAR(95)     NOT NULL,
    RentalFuelOptionAdditionalCost  VARCHAR(105)    NOT NULL
);

--CREATE RESERVATION STATUS TABLE
CREATE TABLE ReservationStatus
(
    ReservationStatusID     TINYINT         PRIMARY KEY
CHECK(ReservationStatusID BETWEEN 1 AND 9),
    ReservationStatusDesc   VARCHAR(30)     NOT NULL

);

--CREATE VEHICLE TABLE
CREATE TABLE Vehicle
(
    VehicleID                       INT IDENTITY(111111,1)  PRIMARY KEY,
    VINNumber                       CHAR(17)                UNIQUE NOT NULL,
    Make                            VARCHAR(40)             NOT NULL,
    Model                           VARCHAR(40)             NOT NULL,
    Year                            SMALLINT                NOT NULL,
    Color                           VARCHAR(27)             NOT NULL,
    LicensePlateNumber              VARCHAR(15)             NOT NULL,
    LicensePlateState               CHAR(2)                 NOT NULL,
    Mileage                         INT                     CHECK(Mileage
BETWEEN 1 AND 300000) NOT NULL,
    TransmissionType                VARCHAR(50)             NOT NULL,
    SeatCapacity                    TINYINT                 NOT NULL,
    VehicleRentalCategoryID         TINYINT
CHECK(VehicleRentalCategoryID BETWEEN 1 AND 25) NOT NULL,
    VehicleStatusID                 TINYINT
CHECK(VehicleStatusID BETWEEN 1 AND 9) NOT NULL,
    VehicleOwningAgencyID           INT                     NOT NULL,
    VehicleCurrentLocationAgencyID  INT                     NOT NULL,
    VehicleType                     CHAR(1)                 NOT NULL,

    CONSTRAINT fk_VehicleRentalCategoryID_Vehicle
```

```
    FOREIGN KEY (VehicleRentalCategoryID)
    REFERENCES VehicleRentalCategory(VehicleRentalCategoryID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_VehicleStatusID_Vehicle
    FOREIGN KEY (VehicleStatusID)
    REFERENCES VehicleStatus(VehicleStatusID)
    ON DELETE CASCADE ON UPDATE CASCADE,


    CONSTRAINT fk_VehicleOwningAgencyID_Vehicle
    FOREIGN KEY (VehicleOwningAgencyID)
    REFERENCES RentalAgency(RentalAgencyID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_VehicleCurrentLocationAgencyID_Vehicle
    FOREIGN KEY (VehicleCurrentLocationAgencyID)
    REFERENCES RentalAgency(RentalAgencyID)
);

--CREATE CAR TABLE
CREATE TABLE Car
(
    VehicleID       INT             PRIMARY KEY,
    TrunkCapacity   Decimal(4,1)    NOT NULL,

    CONSTRAINT fk_VehicleID_Car
    FOREIGN KEY (VehicleId)
    REFERENCES Vehicle(VehicleID)
    ON DELETE CASCADE ON UPDATE CASCADE

);

--CREATE SUV TABLE
CREATE TABLE Suv
(
    VehicleID       INT         PRIMARY KEY,
    TowingCapacity  SMALLINT    NOT NULL,
    IsAWD           BIT         NOT NULL,

    CONSTRAINT fk_VehicleID_Suv
    FOREIGN KEY (VehicleId)
    REFERENCES Vehicle(VehicleID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE MINIVAN TABLE
CREATE TABLE Minivan
(
    VehicleID           INT     PRIMARY KEY,
    HasDiabilityOption  BIT     NOT NULL,

    CONSTRAINT fk_VehicleID_Minivan
    FOREIGN KEY (VehicleId)
    REFERENCES Vehicle(VehicleID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE CARGOVAN TABLE
```

```
CREATE TABLE Cargovan
(
    VehicleID       INT             PRIMARY KEY,
    CargoCapacity   DECIMAL(4,1)    NOT NULL,
    MaximumPayload  SMALLINT        NOT NULL,

    CONSTRAINT fk_VehicleID_Cargovan
    FOREIGN KEY (VehicleId)
    REFERENCES Vehicle(VehicleID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE RESERVATION TABLE
CREATE TABLE Reservation
(
    ReservationID               INT         PRIMARY KEY,
    CustomerID                  INT         NOT NULL,
    RentalAgencyID              INT         NOT NULL,
    VehicleRentalCategoryID     TINYINT     CHECK(VehicleRentalCategoryID
BETWEEN 1 AND 25) NOT NULL,
    ReservationDropOffAgencyID  INT         NOT NULL,
    ReservationPickUpDate       DATE        NOT NULL,
    ReservationPickUpTime       INT         CHECK(ReservationPickUpTime
BETWEEN 0000 AND 2400) NOT NULL,
    ReservationDropOffDate      DATE        NOT NULL,
    ReservationDropOffTime      INT         CHECK(ReservationDropOffTime
BETWEEN 0000 AND 2400) NOT NULL,
    ReservationStatusID         TINYINT     CHECK(ReservationStatusID BETWEEN
1 AND 9) NOT NULL,

    CONSTRAINT fk_CustomerID_Reservation
    FOREIGN KEY (CustomerID)
    REFERENCES Customer(CustomerID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_ReservationAgencyID_Reservation
    FOREIGN KEY (RentalAgencyID)
    REFERENCES RentalAgency(RentalAgencyID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_VehicleRentalCategoryID_Reservation
    FOREIGN KEY (VehicleRentalCategoryID)
    REFERENCES VehicleRentalCategory(VehicleRentalCategoryID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_ReservationDropOffAgencyID_Reservation
    FOREIGN KEY (ReservationDropOffAgencyID)
    REFERENCES RentalAgency(RentalAgencyID),

    CONSTRAINT fk_ReservationStatusID_Reservation
    FOREIGN KEY (ReservationStatusID)
    REFERENCES ReservationStatus(ReservationStatusID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE RENTAL TABLE
CREATE TABLE Rental
(
    RentalAgreementID           INT             PRIMARY KEY,
```

```
    CustomerID                  INT             NOT NULL,
    VehicleID                   INT             NOT NULL,
    RentalAgencyID              INT             NOT NULL,
    RentalDropOffAgencyID       INT             NOT NULL,
    ReservationID               INT             NULL,
    RentalPickUpDate            DATE            NOT NULL,
    RentalPickUpTime            INT             CHECK(RentalPickUpTime
BETWEEN 0000 AND 2400) NOT NULL,
    RentalDropOffDate           DATE            NOT NULL,
    RentalDropOffTime           INT             CHECK(RentalDropOffTime
BETWEEN 0000 AND 2400) NOT NULL,
    RentalPickUpOdometerValue   INT
CHECK(RentalPickUpOdometerValue BETWEEN 0 AND 300000) NOT NULL,
    RentalDropOffOdometerValue  INT
CHECK(RentalDropOffOdometerValue BETWEEN 0 AND 300000) NOT NULL,
    RentalFuelOptionID          TINYINT         CHECK(RentalFuelOptionID
BETWEEN 1 AND 5) NOT NULL,
    InsuranceOptionID           TINYINT         CHECK(InsuranceOptionID
BETWEEN 1 AND 8) NOT NULL,
    RentalStatusID              TINYINT         CHECK(RentalStatusID BETWEEN
1 AND 10) NOT NULL,
    RentalDeposit               DECIMAL(7,2)    NOT NULL,

    CONSTRAINT fk_CustomerID_Rental
    FOREIGN KEY (CustomerID)
    REFERENCES Customer(CustomerID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_VehicleID_Rental
    FOREIGN KEY (VehicleID)
    REFERENCES Vehicle(VehicleID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_RentalAgencyID_Rental
    FOREIGN KEY (RentalAgencyID)
    REFERENCES RentalAgency(RentalAgencyID),

    CONSTRAINT fk_RentalDropOffAgencyID_Rental
    FOREIGN KEY (RentalDropOffAgencyID)
    REFERENCES RentalAgency(RentalAgencyID),

    CONSTRAINT fk_ReservationID_Rental
    FOREIGN KEY (ReservationID)
    REFERENCES Reservation(ReservationID),

    CONSTRAINT fk_RentalFuelOptionID_Rental
    FOREIGN KEY (RentalFuelOptionID)
    REFERENCES FuelOption(RentalFuelOptionID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_InsuranceOptionID_Rental
    FOREIGN KEY (InsuranceOptionID)
    REFERENCES RentalInsuranceOption(InsuranceOptionID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_RentalStatusID_Rental
    FOREIGN KEY (RentalStatusID)
    REFERENCES RentalStatus(RentalStatusID)
    ON DELETE CASCADE ON UPDATE CASCADE
```

```
);

CREATE TABLE TransportStatus(
    TransportStatusID       TINYINT         PRIMARY KEY
CHECK(TransportStatusID BETWEEN 1 AND 9),
    TransportStatusDesc     VARCHAR(80)     NOT NULL
);

CREATE TABLE TransportReason(
    TransportReasonID       TINYINT         PRIMARY KEY
CHECK(TransportReasonID BETWEEN 1 AND 9),
    TransportReasonDesc     VARCHAR(80)     NOT NULL
);

CREATE TABLE Transport(
    EmployeeID              INT         NOT NULL,
    VehicleID               INT         NOT NULL,
    PickUpRentalAgencyID    INT         NOT NULL,
    DropOffRentalAgencyID   INT         NOT NULL,
    DriverDepartureDate     DATE        NOT NULL,
    DriverDepartureTime     SMALLINT    CHECK(DriverDepartureTime BETWEEN 0
AND 2400) NOT NULL,
    VehiclePickUpDate       DATE        NOT NULL,
    VehiclePickUpTime       SMALLINT    CHECK(VehiclePickUpTime BETWEEN 0 AND
2400) NOT NULL,
    VehicleDropOffDate      DATE        NOT NULL,
    VehicleDropOffTime      SMALLINT    CHECK(VehicleDropOffTime BETWEEN 0
AND 2400) NOT NULL,
    TransportStatusID       TINYINT     CHECK(TransportStatusID BETWEEN 1 AND
9) NOT NULL,
    TransportReasonID       TINYINT     CHECK(TransportReasonID BETWEEN 1 AND
9) NOT NULL,

    CONSTRAINT pk_Transport
    PRIMARY KEY (EmployeeID, VehicleID, PickUpRentalAgencyID),

    CONSTRAINT fk_EmployeeID_Transport
    FOREIGN KEY (EmployeeID)
    REFERENCES Employee(EmployeeID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_VehicleID_Transport
    FOREIGN KEY (VehicleID)
    REFERENCES Vehicle(VehicleID)
    ON DELETE CASCADE ON UPDATE CASCADE,

    CONSTRAINT fk_PickUpRentalAgencyID_Transport
    FOREIGN KEY (PickUpRentalAgencyID)
    REFERENCES RentalAgency(RentalAgencyID),

    CONSTRAINT fk_DropOffRentalAgencyID_Transport
    FOREIGN KEY (DropOffRentalAgencyID)
    REFERENCES RentalAgency(RentalAgencyID),

    CONSTRAINT fk_TransportStatusID_Transport
    FOREIGN KEY (TransportStatusID)
    REFERENCES TransportStatus(TransportStatusID)
    ON DELETE CASCADE ON UPDATE CASCADE,
```

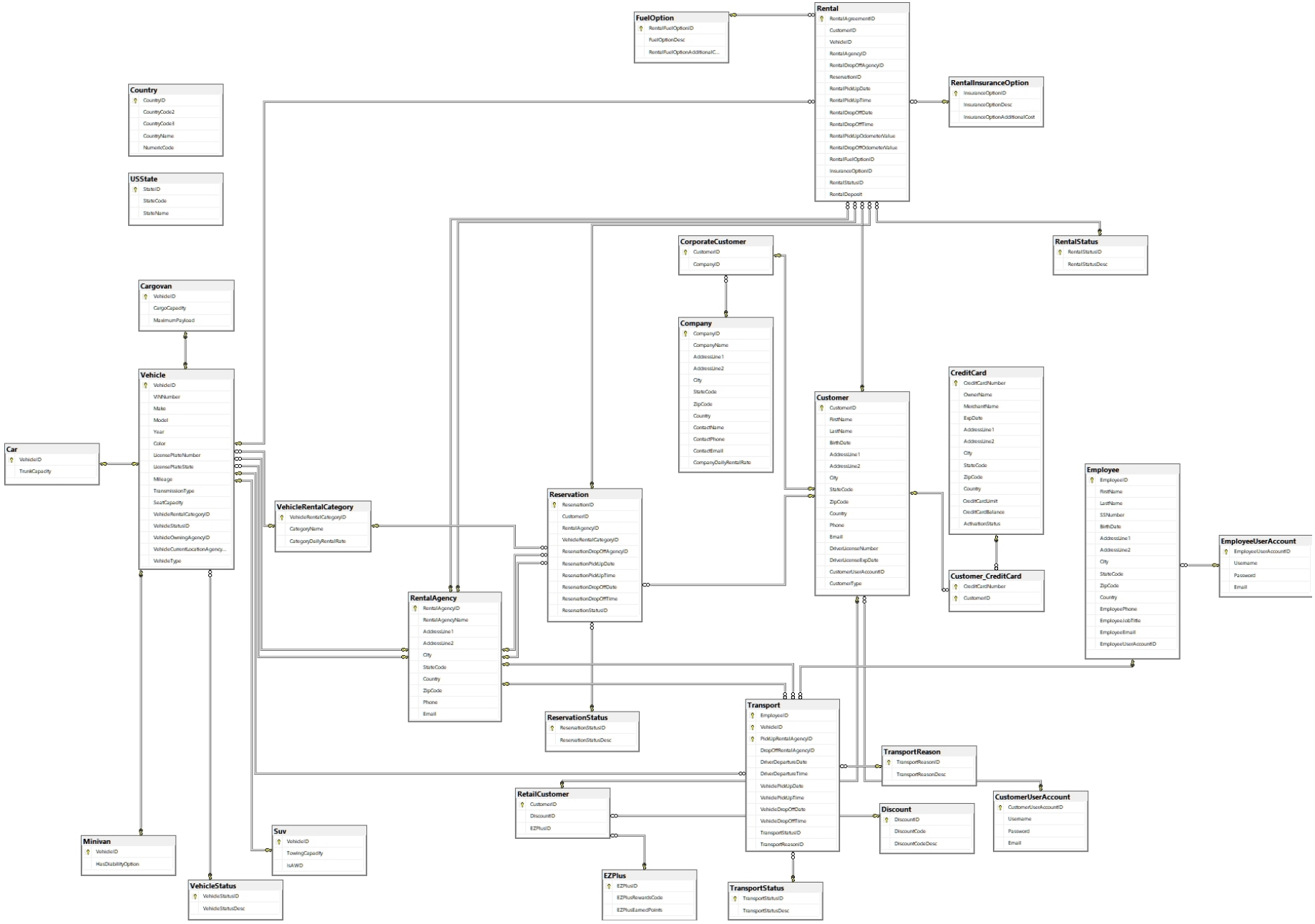
```
    CONSTRAINT fk_TransportReasonID_Transport
    FOREIGN KEY (TransportReasonID)
    REFERENCES TransportReason(TransportReasonID)
    ON DELETE CASCADE ON UPDATE CASCADE
);

--CREATE COUNTRY TABLE
CREATE TABLE Country
(
    CountryID       TINYINT         PRIMARY KEY,
    CountryCode2    CHAR(2)         UNIQUE NOT NULL,
    CountryCode3    CHAR(3)         UNIQUE NOT NULL,
    CountryName     VARCHAR(60)     NOT NULL,
    NumericCode     SMALLINT        CHECK(NumericCode BETWEEN 1 AND 999) NOT
NULL
);

--CREATE USSTATE TABLE
CREATE TABLE USState
(
    StateID     TINYINT         PRIMARY KEY CHECK(StateID BETWEEN 1 AND 51),
    StateCode   CHAR(2)         UNIQUE NOT NULL,
    StateName   VARCHAR(20)     NOT NULL
);
```

DEVELOPMENT & IMPLEMENTATION PHYSICAL SCHEMA DIAGRAM

The diagram below was generated from Microsoft SQL Management Studio after the execution of the DDL script above.



DATABASE DEVELOPMENT & IMPLEMENTATION UNIT TESTING

This section shows the script used to test a select group of entities, using Data Manipulation Language statements (DML) (Insert, Select, Update and Delete). The table group consist of binary relationships between tables, an associative table relationship, and a Supertype/Subtype Parent with multiple children were selected for testing.

INSERT STATEMENTS

CREDITCARD TABLE

Populated the CreditCard table which was the first parent to the Associative Child table – CustomerCreditCard

```
INSERT INTO CreditCard (CreditCardNumber, OwnerName, MerchantName, ExpDate, AddressLine1,  AddressLine2,City,
StateCode, ZipCode, Country, CreditCardBalance, CreditCardLimit, ActivationStatus)
VALUES('4004000000000001', 'Eric Smith', 'Visa', '07/01/2023', '55 Water St.', 'Apt 26', 'New York', 'NY','10041', 'USA',
'200.00', '2000.00',1);

INSERT INTO CreditCard (CreditCardNumber, OwnerName, MerchantName, ExpDate, AddressLine1, AddressLine2,City,
StateCode, ZipCode, Country, CreditCardBalance, CreditCardLimit, ActivationStatus)
VALUES('4004000000000002', 'Sandy Yu', 'Visa', '03/03/2024', '37 Main St.', 'Apt 2B', 'Queens', 'NY','11355', 'USA',
'100.00', '1000.00',1);

INSERT INTO CreditCard (CreditCardNumber, OwnerName, MerchantName, ExpDate, AddressLine1, AddressLine2,City,
StateCode, ZipCode, Country, CreditCardBalance, CreditCardLimit, ActivationStatus)
VALUES('4004000000000003', 'Rafael Nunez', 'Mastercard', '08/04/2024', '10 Beverly', 'Apt 1', 'Hollywood', 'CA', '40171',
'USA', '200.00', '2000.00',1);

INSERT INTO CreditCard (CreditCardNumber, OwnerName, MerchantName, ExpDate, AddressLine1, AddressLine2,City,
StateCode, ZipCode, Country, CreditCardBalance, CreditCardLimit, ActivationStatus)
VALUES('4004000000000004', 'Tim Tucker', 'Visa', '11/27/2024', '65 Pine St.', 'Suite 306', 'Brooklyn', 'NY', '11473', 'USA',
'100.00', '1000.00',1);

INSERT INTO CreditCard (CreditCardNumber, OwnerName, MerchantName, ExpDate, AddressLine1, AddressLine2,City,
StateCode, ZipCode, Country, CreditCardBalance, CreditCardLimit, ActivationStatus)
VALUES('4004000000000005', 'Sam Williams', 'Mastercard', '01/14/2025', '77-18 108 St.', 'Apt 2', 'Queens', 'NY','11368',
'USA', '200.00', '2000.00',1);
```

CreditCard table populated with 5 rows after executing Insert statements.

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardBalance	CreditCardLimit	ActivationStatus
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	200.00	2000.00	1
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	100.00	1000.00	1
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	200.00	2000.00	1
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	100.00	1000.00	1
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	200.00	2000.00	1

CUSTOMER TABLE

Populated the Customer table which was the second parent to the Associative Child table – CustomerCreditCard

```
INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Eric', 'Smith', '07/01/1983', '55 Water St.', 'Apt 26', 'New York', 'NY',
'10041', 'USA', '646-111-11-11', 'e.smith@gmail.com', '1111111111', '07/01/2030','R');

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Sandy', 'Yu', '03/03/1992', '37 Main St.', 'Apt 2B', 'Queens', 'NY',
'11355', 'USA', '646-222-22-22', 's.yu@gmail.com', '2222222222', '03/03/2030', 'R');

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Rafael', 'Nunez', '08/04/1987', '10 Beverly', 'Apt 1', 'Hollywood', 'CA',
'40171', 'USA', '646-333-33-33', 'r.nunez@gmail', '3333333333', '08/04/2030', 'R');

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Tim', 'Tucker', '11/27/1980', '65 Pine St.', 'Suite 306', 'Brooklyn', 'NY',
'11473', 'USA', '646-444-44-44', 't.tucker@gmail.com', '4444444444', '11/27/2030', 'R');

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Sam', 'Williams', '01/14/2025', '77-18 108 St.', 'Apt 2', 'Queens', 'NY',
'11368', 'USA', '646-555-55-55', 's.williams@gmail.com', '5555555555', '01/14/2030', 'R');
```

Customer table populated with 5 rows after executing Insert statements. CustomerID was automatically populated by Identity constraint and CustomerUserAccountID is set to NULL.

	CustomerID	FirstName	LastName	BirthDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	Phone	Email	DriverLicenseNumber	DriverLicenseExpDate	CustomerUserAccountID	CustomerType
1	11111111	Eric	Smith	1983-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	646-111-11-11	e.smith@gmail.com	1111111111	2030-07-01	NULL	R
2	11111112	Sandy	Yu	1992-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	646-222-22-22	s.yu@gmail.com	2222222222	2030-03-03	NULL	R
3	11111113	Rafael	Nunez	1987-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	646-333-33-33	r.nunez@gmail	3333333333	2030-08-04	NULL	R
4	11111114	Tim	Tucker	1980-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	646-444-44-44	t.tucker@gmail.com	4444444444	2030-11-27	NULL	R
5	11111115	Sam	Williams	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	646-555-55-55	s.williams@gmail.com	5555555555	2030-01-14	NULL	R

CUSTOMERCREDITCARD TABLE

Populated CustomerCreditcard which is the associative child of both CreditCard and Customer parent tables.

```
INSERT INTO Customer_CreditCard(CustomerID, CreditCardNumber)
VALUES('11111116','4004000000000001');

INSERT INTO Customer_CreditCard(CustomerID, CreditCardNumber)
VALUES('11111117','4004000000000002');

INSERT INTO Customer_CreditCard(CustomerID, CreditCardNumber)
VALUES('11111118','4004000000000003');

INSERT INTO Customer_CreditCard(CustomerID, CreditCardNumber)
VALUES('11111119','4004000000000004');

INSERT INTO Customer_CreditCard(CustomerID, CreditCardNumber)
VALUES('11111120','4004000000000005');
```

CustomerCreditCard table populated with 5 rows after executing Insert statements which kept consistent with data from the parent tables, Customer and CreditCard.

	CreditCardNumber	CustomerID
1	4004000000000001	11111116
2	4004000000000002	11111117
3	4004000000000003	11111118
4	4004000000000004	11111119
5	4004000000000005	11111120

RETAILCUSTOMER TABLE

Populated the Supertype/Subtype parent and child tables. The Supertype parent is the Customer table and the Subtype child tables are the Retail Customer and the Corporate Customer. The Customer table is populated first and then RetailCustomer child table.

```
INSERT INTO RetailCustomer(CustomerID, DiscountID, EZPlusID)
VALUES(11111116, 2, 3);

INSERT INTO RetailCustomer(CustomerID, DiscountID, EZPlusID)
VALUES(11111117, 4, 2);

INSERT INTO RetailCustomer(CustomerID, EZPlusID)
VALUES(11111118, 1);

INSERT INTO RetailCustomer(CustomerID, DiscountID)
VALUES(11111119, 4);

INSERT INTO RetailCustomer(CustomerID, DiscountID, EZPlusID)
VALUES(11111120, 1, 4);
```

RetailCustomer table populated with 5 rows after executing Insert statements. Customer table had to be populated with retail customers before executing these insert statements. DiscountID and EZPlusID allow NULL values.

	CustomerID	DiscountID	EZPlusID
1	11111116	2	3
2	11111117	4	2
3	11111118	NULL	1
4	11111119	4	NULL
5	11111120	1	4

COMPANY TABLE

Populated the Company table which has a binary relationship to the CorporateCustomer table.

```
INSERT INTO Company (CompanyID, CompanyName, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
ContactName, ContactPhone, ContactEmail, CompanyDailyRentalRate)
VALUES(1111, 'VTech', '1 Tech Dr.', 'Suite 306', 'Silicon Valley', 'CA', '30331', 'USA', 'John Terry', '718-111-11-11',
'j.terry@outlook.com', 100.00);

INSERT INTO Company (CompanyID, CompanyName, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
ContactName, ContactPhone, ContactEmail, CompanyDailyRentalRate)
VALUES(2222, 'Yellow LLC', '380 Park Ave.', 'Fl 52', 'New York', 'NY', '10101', 'USA', 'David Silva', '718-222-22-22',
'd.silva@outlook.com', 100.00);

INSERT INTO Company (CompanyID, CompanyName, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
ContactName, ContactPhone, ContactEmail, CompanyDailyRentalRate)
VALUES(3333, 'Together INC', '420 Santa St', 'Fl 1', 'Santa Fe', 'CA', '34001', 'USA', 'Marco Alonso', '718-333-33-33',
'm.alonso@outlook.com', 100.00);

INSERT INTO Company (CompanyID, CompanyName, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
ContactName, ContactPhone, ContactEmail, CompanyDailyRentalRate)
VALUES(4444, 'Starfire Inc.', '541 Flatbush Ave', 'Fl 10', 'Brooklyn', 'NY', '11235', 'USA', 'Iker Casillas', '718-444-44-44',
'i.casillas@outlook.com', 100.00);

INSERT INTO Company (CompanyID, CompanyName, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
ContactName, ContactPhone, ContactEmail, CompanyDailyRentalRate)
VALUES(5555, 'Ionized LLC', '315 W15th St.', 'Fl 4', 'New York', 'NY', '10014', 'USA', 'Luka Modric', '718-555-55-55',
'l.modric@outlook.com', 100.00);
```

Company table populated with 5 rows after executing Insert statements.

	CompanyID	CompanyName	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	ContactName	ContactPhone	ContactEmail	CompanyDailyRentalRate
1	1111	VTech	1 Tech Dr.	Suite 306	Silicon Valley	CA	30331	USA	John Terry	718-111-11-11	j.terry@outlook.com	100.00
2	2222	Yellow LLC	380 Park Ave.	Fl 52	New York	NY	10101	USA	David Silva	718-222-22-22	d.silva@outlook.com	100.00
3	3333	Together INC	420 Santa St	Fl 1	Santa Fe	CA	34001	USA	Marco Alonso	718-333-33-33	m.alonso@outlook.com	100.00
4	4444	Starfire Inc.	541 Flatbush Ave	Fl 10	Brooklyn	NY	11235	USA	Iker Casillas	718-444-44-44	i.casillas@outlook.com	100.00
5	5555	Ionized LLC	315 W15th St.	Fl 4	New York	NY	10014	USA	Luka Modric	718-555-55-55	l.modric@outlook.com	100.00

CORPORATECUSTOMER TABLE

Populated the Supertype/Subtype parent and child tables. The Supertype parent is the Customer table and the Subtype child tables are the Retail Customer and the Corporate Customer. The Customer table is populated first and then CorporateCustomer child table (note that extra Corporate Customers were added in the script below).

```
INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('George', 'Lopez', '09/29/1979', '806 Park Ave.', 'Apt 8C', 'New York', 'NY',
'10041', 'USA', '646-676-66-66', 'g.lopez@gmail.com', '66666666', '09/29/2030','C');

INSERT INTO CorporateCustomer(CustomerID,CompanyID)
VALUES(11111121, 1111);

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Samuel', 'Anderson', '06/07/1993', '307 Jensen Ave.', 'Apt 1', 'Hoboken', 'NJ',
'07197', 'USA', '646-777-77-77', 's.anderson@gmail.com', '7777777', '06/07/2030','C');

INSERT INTO CorporateCustomer(CustomerID,CompanyID)
VALUES(11111122, 2222);

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Ben', 'Thomas', '04/17/1987', '99 Court St.', 'Apt 3', 'Bronx', 'NY',
'11777', 'USA', '646-888-88-88', 'b.thomas@gmail.com', '88888888', '04/17/2030','C');

INSERT INTO CorporateCustomer(CustomerID,CompanyID)
VALUES(11111123, 3333);

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Jack', 'Brown', '03/19/1991', '10 Burn Rd.', 'Apt 1', 'North Bergen', 'NJ',
'21714', 'USA', '646-999-99-99', 'j.browngmail.com', '999999999', '03/19/2030','C');

INSERT INTO CorporateCustomer(CustomerID,CompanyID)
VALUES(11111124, 4444);

INSERT INTO Customer (FirstName, LastName, BirthDate, AddressLine1, AddressLine2, City, StateCode, ZipCode, Country,
Phone, Email, DriverLicenseNumber, DriverLicenseExpDate, CustomerType)
VALUES('Robert', 'Sanchez', '02/01/1990', '109-10 Prent Ave.', 'Apt 2', 'Staten Island', 'NY',
'11001', 'USA', '646-888-99-99', 'r.sanchez@gmail.com', '123456789', '02/01/2030','C');

INSERT INTO CorporateCustomer(CustomerID,CompanyID)
VALUES(11111125, 5555);
```

CorporateCustomer table populated with 5 rows after executing Insert statements.

	CustomerID	CompanyID
1	11111121	1111
2	11111122	2222
3	11111123	3333
4	11111124	4444
5	11111125	5555

DISCOUNT TABLE

Populated the Discount table which has a binary relationship to the RetailCustomer table.

```
INSERT INTO Discount(DiscountCode, DiscountCodeDesc)
VALUES('AAA99700', 'AAA Membership Discount - 25% off base rate plus 10% donated for breast cancer research.');

INSERT INTO Discount(DiscountCode, DiscountCodeDesc)
VALUES('GOV87569', 'Government Employee Discount - 30% off base rate');

INSERT INTO Discount(DiscountCode, DiscountCodeDesc)
VALUES('STA34156', 'State Employee Discount for 25% off base rate');

INSERT INTO Discount(DiscountCode, DiscountCodeDesc)
VALUES('VET20551', 'Veteran Discount 35% off base rate Plus 10% donation to veteran's family fund.');

INSERT INTO Discount(DiscountCode, DiscountCodeDesc)
VALUES('CNY98765', 'Cuny Student Discount for 10% off base rate');
```

Discount table populated with 5 rows after executing Insert statements.

DiscountID	DiscountCode	DiscountCodeDesc
1	AAA99700	AAA Membership Discount - 25% off base rate plus...
2	GOV87569	Government Employee Discount - 30% off base rate
3	STA34156	State Employee Discount for 25% off base rate
4	VET20551	Veteran Discount 35% off base rate Plus 10% dona...
5	CNY98765	Cuny Student Discount for 10% off base rate

EZPLUS TABLE

Populated the EZPlus table which has a binary relationship to the RetailCustomer table.

```
INSERT INTO EZPlus(EZPlusRewardsCode,EZPlusEarnedPoints)
VALUES('EZP90098', 10000);

INSERT INTO EZPlus(EZPlusRewardsCode,EZPlusEarnedPoints)
VALUES('EZP10001', 500);

INSERT INTO EZPlus(EZPlusRewardsCode,EZPlusEarnedPoints)
VALUES('EZP64932', 159000);

INSERT INTO EZPlus(EZPlusRewardsCode,EZPlusEarnedPoints)
VALUES('EZP20051', 23000);
```

EZPlus table populated with 4 rows with the existing Rewards Program, after executing Insert statements.

	EZPlusID	EZPlusRewardsCode	EZPlusEarnedPoints
1	1	EZP90098	10000
2	2	EZP10001	500
3	3	EZP64932	159000
4	4	EZP20051	23000

CUSTOMERUSERACCOUNT TABLE

Populated the CustomerUserAccount table which has a binary relationship to the Customer table.

```
INSERT INTO CustomerUserAccount(Username,Password,Email)
VALUES('e.smith', 'abc111', 'e.smith@gmail.com');

INSERT INTO CustomerUserAccount(Username,Password,Email)
VALUES('r.nunez', 'abc112', 'r.nunez@gmail.com');

INSERT INTO CustomerUserAccount(Username,Password,Email)
VALUES('t.tucker', 'abc113', 't.tucker@gmail.com');

INSERT INTO CustomerUserAccount(Username,Password,Email)
VALUES('s.anderson', 'abc114', 's.anderson@gmail.com');

INSERT INTO CustomerUserAccount(Username,Password,Email)
VALUES('r.sanchez', 'abc115', 'r.sanchez@gmail.com');
```

CustomerUserAccount table populated with 5 rows after executing Insert statements. CustomerUserAccountID was automatically populated due to the Uniqueidentifier constraint.

	CustomerUserAccountID	Username	Password	Email
1	C53A1EA1-9FCB-41F1-9512-0EF0F5E22130	r.sanchez	abc115	r.sanchez@gmail.com
2	2A5D95AE-ECA9-4549-9855-3598C701B55D	t.tucker	abc113	t.tucker@gmail.com
3	D143403A-7B46-48D3-BC54-4CAAFDE2E095	r.nunez	abc112	r.nunez@gmail.com
4	BA141805-2B32-43AB-83F4-65622AB83909	e.smith	abc111	e.smith@gmail.com
5	B2DEAFF4-9DE9-4202-B17B-864CA170302B	s.anderson	abc114	s.anderson@gmail.com

SELECT STATEMENTS

SELECT STATEMENT 2

Select Statement on Customer table from the table group, to return only one record with all columns which is based on the Primary Key - CustomerID.

```
SELECT * FROM Customer
WHERE CustomerID = 11111115;
```

The query returned the record with all its columns from the Customer table which has an ID number of 11111115.

	CustomerID	FirstName	LastName	BirthDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	Phone	Email	DriverLicenseNumber	DriverLicenseExpDate	CustomerUserAccountID	CustomerType
1	11111115	Sam	Williams	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	646-555-55-55	s.williams@gmail.com	5555555555	2030-01-14	NULL	R

SELECT STATEMENT 2

Select Statement on Company table which returned multiple records and includes all columns based on criteria other than the primary key.

```
SELECT * FROM Company
WHERE StateCode = 'CA' AND Country = 'USA';
```

The query returned the records which have, “CA” in StateCode column and “USA” in the country column, with all the columns.

	CompanyID	CompanyName	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	ContactName	ContactPhone	ContactEmail	CompanyDailyRentalRate
1	1111	VTech	1 Tech Dr.	Suite 306	Silicon Valley	CA	30331	USA	John Terry	718-111-11-11	j.terry@outlook.com	100.00
2	3333	Together INC	420 Santa St	Fl 1	Santa Fe	CA	34001	USA	Marco Alonso	718-333-33-33	m.alonso@outlook.com	100.00

SELECT STATEMENT 3

Select statement on Customer, CreditCard, and CustomerCreditCard tables which have an associative entity relationship and returned one or multiple records with columns from each table.

Business Scenario: What credit card number does the customer Tim Tucker have and its balance? Include first name, last name, card number, birth date, email, card merchant name, and balance.

```
SELECT Customer.FirstName, Customer.LastName, ccc.CreditCardNumber, Customer.BirthDate, Customer.Email,
CreditCard.MerchantName, CreditCard.CreditCardBalance
FROM Customer, CustomerCreditCard as ccc, CreditCard
WHERE Customer.CustomerID = ccc.CustomerID AND ccc.CreditCardNumber = CreditCard.CreditCardNumber AND
OwnerName = 'Tim Tucker';
```

The query returned the specified columns from each table which are joined Customer to CustomerCreditCard and CustomerCreditCard to CreditCard, where the OwnerName is “Tim Tucker”. An Alias was added for the CustomerCreditCard, ccc, to simplify statement.

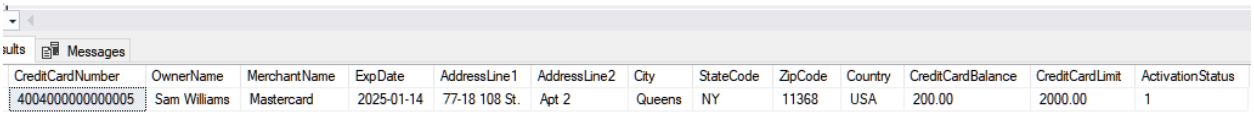
	FirstName	LastName	CreditCardNumber	BirthDate	Email	MerchantName	CreditCardBalance
1	Tim	Tucker	4004000000000004	1980-11-27	t.tucker@gmail.com	Visa	100.00

UPDATE STATEMENTS

UPDATE STATEMENT 1

A select statement was executed to display the content on the record before updating.

```
SELECT * FROM CreditCard WHERE CreditCardNumber = 4004000000000005;
```



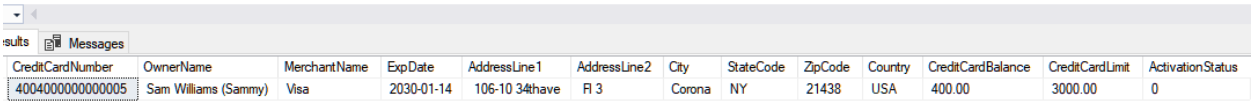
CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardBalance	CreditCardLimit	ActivationStatus
4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	200.00	2000.00	1

The following UPDATE statement was used to update the content of the record.

```
UPDATE  CreditCard
SET                 OwnerName = 'Sam Williams (Sammy)',
                    MerchantName= 'Visa',
                    ExpDate = '01/14/2030',
                    AddressLine1 = ' 106-10 34thave',
                    AddressLine2 = ' Fl 3',
                    City = 'Corona',
                    StateCode = 'NY',
                    ZipCode= '21438',
                    Country = 'USA',
                    CreditCardBalance = 400.00,
                    CreditCardLimit = 3000.00,
                    ActivationStatus = 0
WHERE CreditCardNumber = 4004000000000005
```

Executed the Select statement again to verify that the columns were updated.

```
SELECT * FROM CreditCard WHERE CreditCardNumber = 4004000000000005;
```

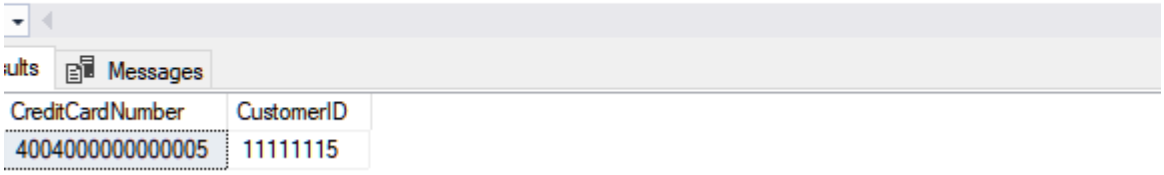


CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardBalance	CreditCardLimit	ActivationStatus
4004000000000005	Sam Williams (Sammy)	Visa	2030-01-14	106-10 34thave	Fl 3	Corona	NY	21438	USA	400.00	3000.00	0

UPDATE STATEMENT 2

A SELECT statement was executed to display record before updating.

```
SELECT * FROM Customer_CreditCard WHERE CustomerID = 11111115;
```



ults | Messages

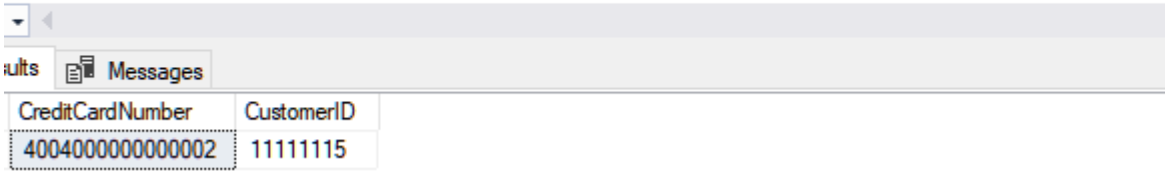
CreditCardNumber	CustomerID
4004000000000005	11111115

The following UPDATE statement was used to update Customer_CreditCard.

```
UPDATE  Customer_CreditCard
SET     CreditCardNumber = 4004000000000002
WHERE   CustomerID = 11111115;
```

Executed the select statement again to verify the column had updated. The credit card number now becomes the same as another record in the table but since it's a composite key, the combination of the card number and customer ID, make it unique.

```
SELECT * FROM Customer_CreditCard WHERE CustomerID = 11111115;
```



ults | Messages

CreditCardNumber	CustomerID
4004000000000002	11111115

DELETE STATEMENTS

DELETE STATEMENT 1

A SELECT statement was executed to display content of the Company table before deletion.

```
SELECT * FROM Company;
```

ults Messages

CompanyID	CompanyName	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	ContactName	ContactPhone	ContactEmail	CompanyDailyRentalRate
1111	VTech	1 Tech Dr.	Suite 306	Silicon Valley	CA	30331	USA	John Terry	718-111-11-11	j.terry@outlook.com	100.00
2222	Yellow LLC	380 Park Ave.	Fl 52	New York	NY	10101	USA	David Silva	718-222-22-22	d.silva@outlook.com	100.00
3333	Together INC	420 Santa St	Fl 1	Santa Fe	CA	34001	USA	Marco Alonso	718-333-33-33	m.alonso@outlook.com	100.00
4444	Starfire Inc.	541 Flatbush Ave	Fl 10	Brooklyn	NY	11235	USA	Iker Casillas	718-444-44-44	i.casillas@outlook.com	100.00
5555	Ionized LLC	315 W15th St.	Fl 4	New York	NY	10014	USA	Luka Modric	718-555-55-55	l.modric@outlook.com	100.00

The following delete statement was executed to remove Together INC from the Company table.

```
DELETE
FROM Company
WHERE CompanyID = 3333;
```

Executed the Select statement again to verify the record was removed from the table.

```
SELECT * FROM Company;
```

ults Messages

CompanyID	CompanyName	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	ContactName	ContactPhone	ContactEmail	CompanyDailyRentalRate
1111	VTech	1 Tech Dr.	Suite 306	Silicon Valley	CA	30331	USA	John Terry	718-111-11-11	j.terry@outlook.com	100.00
2222	Yellow LLC	380 Park Ave.	Fl 52	New York	NY	10101	USA	David Silva	718-222-22-22	d.silva@outlook.com	100.00
4444	Starfire Inc.	541 Flatbush Ave	Fl 10	Brooklyn	NY	11235	USA	Iker Casillas	718-444-44-44	i.casillas@outlook.com	100.00
5555	Ionized LLC	315 W15th St.	Fl 4	New York	NY	10014	USA	Luka Modric	718-555-55-55	l.modric@outlook.com	100.00

DELETE STATEMENT 2

A SELECT statement was executed to display the contents of Customer_CreditCard table.

```
SELECT * FROM Customer_CreditCard;
```

sults Messages

CreditCardNumber	CustomerID
4004000000000001	11111111
4004000000000002	11111112
4004000000000002	11111115
4004000000000003	11111113
4004000000000004	11111114

The following delete statement was executed to Remove one record from the Customer_CreditCard table.

```
DELETE
FROM Customer_CreditCard
WHERE CustomerID = 11111115 AND CreditCardNumber = 4004000000000002;
```

Executed the select statement again to verify the record was removed from the table.

```
SELECT * FROM Customer_CreditCard;
```

sults | Messages

CreditCardNumber	CustomerID
4004000000000001	11111111
4004000000000002	11111112
4004000000000003	11111113
4004000000000004	11111114

CONCLUSION

A summary of the necessary steps taken to develop and implement the project and all its features.

- Provided the design and implementation of the Client/Server Application Auto Rental Point-of-Sales Management System named EZRental POS for NYC-Tech Solutions Inc.

- Provided an overview of the problem statement and objectives, along with the roles and responsibilities of those involved in the completion of the project.

- Stated business and technical requirements.

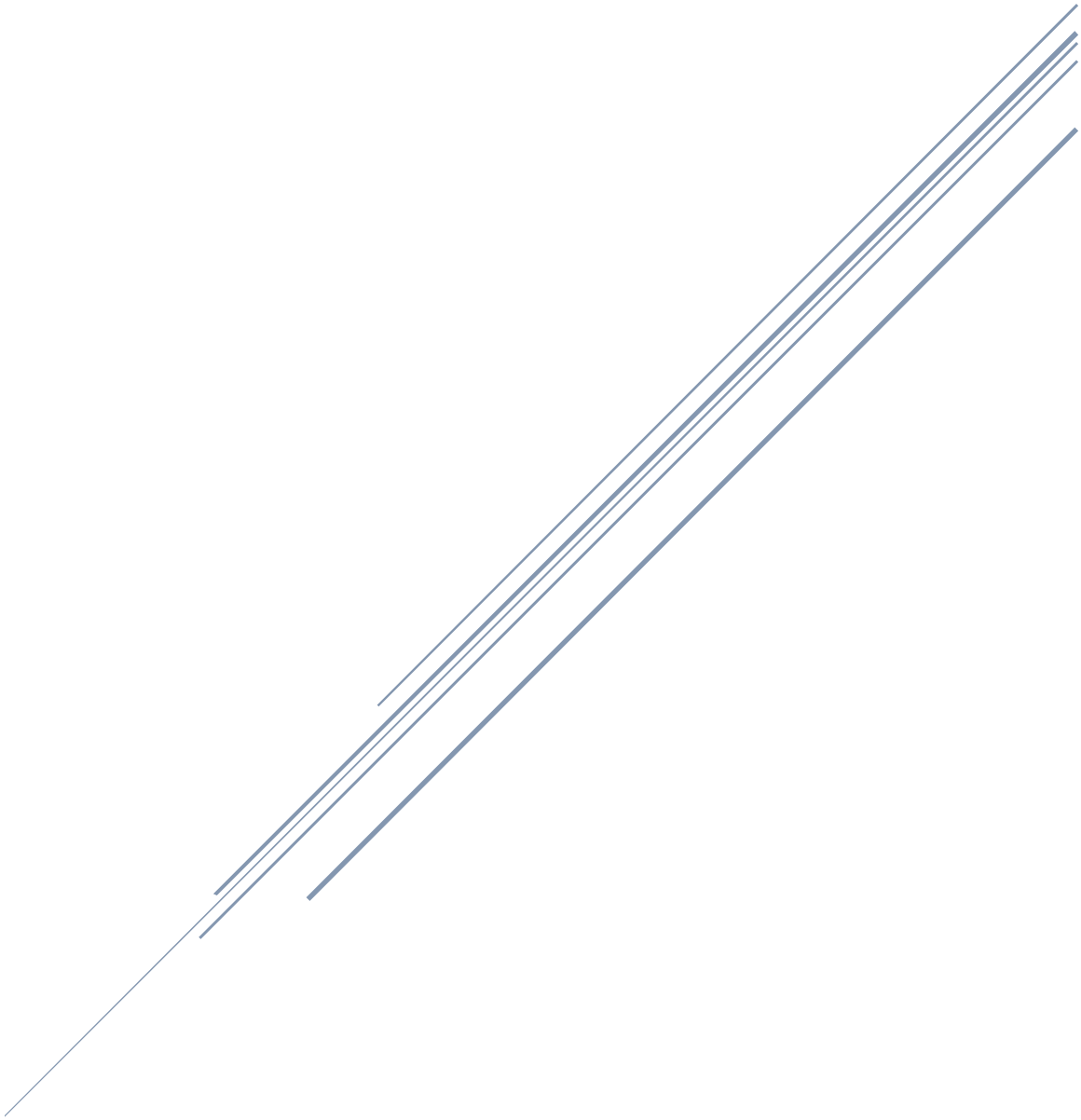
- Gave explanation of proposed application physical architecture including the database management system physical architecture and the project methodology used to achieve the objectives.

- The Database design and implementation to support both the EZRental Point-of-Sales and Back-end Management Systems is shown ready for interaction between the DBMS and the user.

    - Analyzed requirements to derive the database and conceptualized the business requirements using an EER Conceptual Model
    - Designed the Logical Model & Normalized model
    - Designed the Data dictionary derived from the Normalized model
    - Designed the Physical Model Schema Diagram
    - Developed, implemented, and tested the database based on the Physical Model Schema Diagram, using Microsoft SQL Server

EZRENTAL POS WINDOWS APPLICATION DESIGN & IMPLEMENTATION

Auto Rental Point-of-Sales Management System
Project 2



PROJECT 2 OBJECTIVES

This section provides an overview of the next stage for the EZRental Pos project

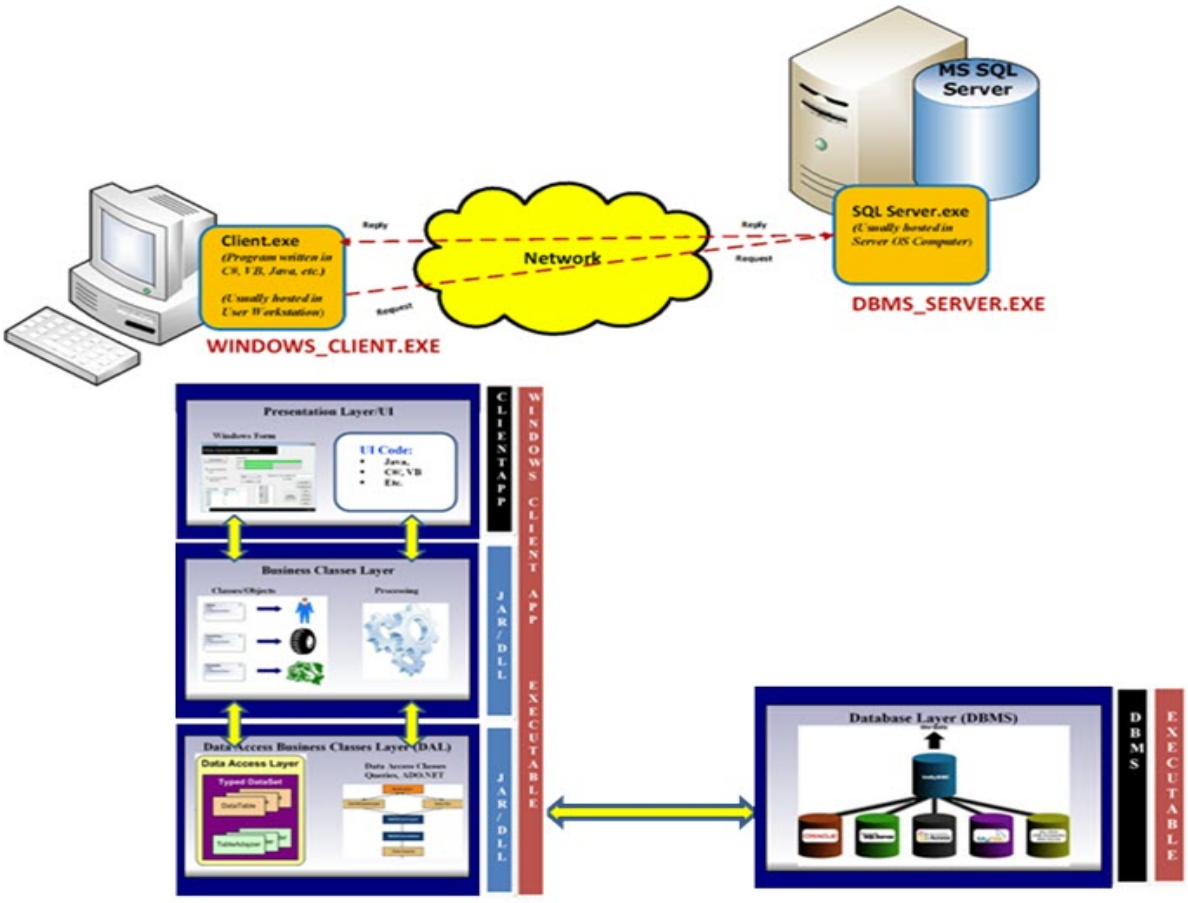
Project Objectives

- Continue the design, development & implementation of the Client/Server Application Auto Rental Point-of-Sales Management System named EZRental POS. Currently, the database has been implemented in the previous section, Project 1. The EZRental Internal Credit Card Back/Front-end Management System has been implemented and will be detailed in this document.
- The project has a list of backlogs that require completion that will also be detailed in the coming pages, which include population of the database tables, customer and employee front and back-end functionalities, login authentication functionality, and an e-commerce website named EZrental.com. There are a total of 14 features in the backlog, however only the Credit Card Management System backlog will be implemented in this section.
- The basic project objectives remain the same
    - The EZRental POS System is designed to allow retail and corporate customer to reserve & rent vehicles like companies such as Avis, Hertz, Budget, etc.
    - The application is designed to support dozens of major cities around the world. The company currently has rental agency branches in US, Canada, Mexico, United Kingdom, Japan & Australia and looking to expand further globally into other markets in Asia, Africa, and the Mediterranean.
    - It must provide a great user experience.

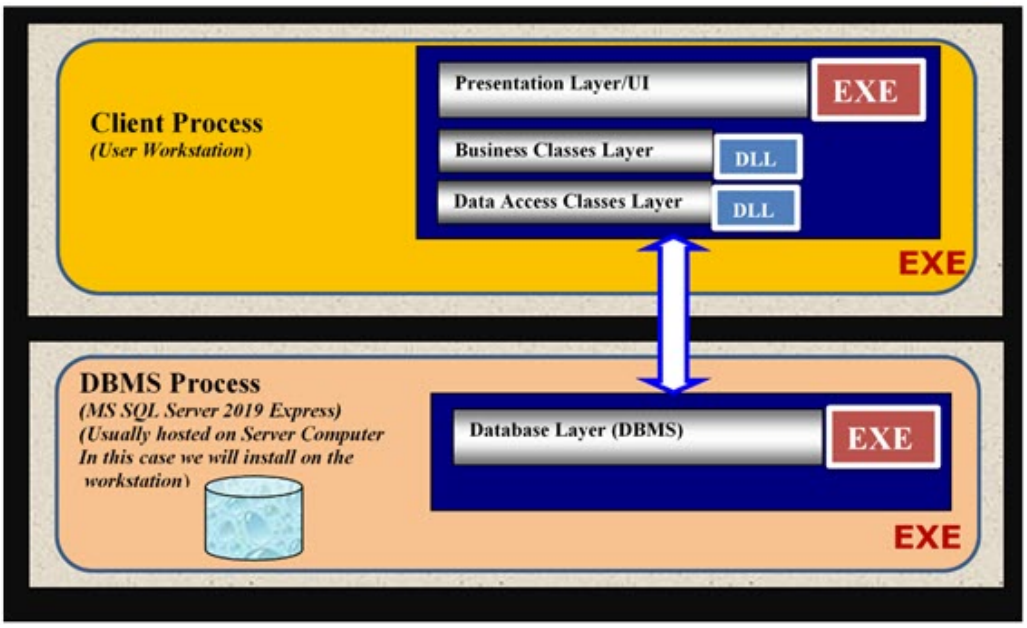
Project N-Tier Software Application Development Architecture

This section explains the software application development architecture chosen for the client application. The targeted Architecture is a Windows 4-Tiered- Client/Server.

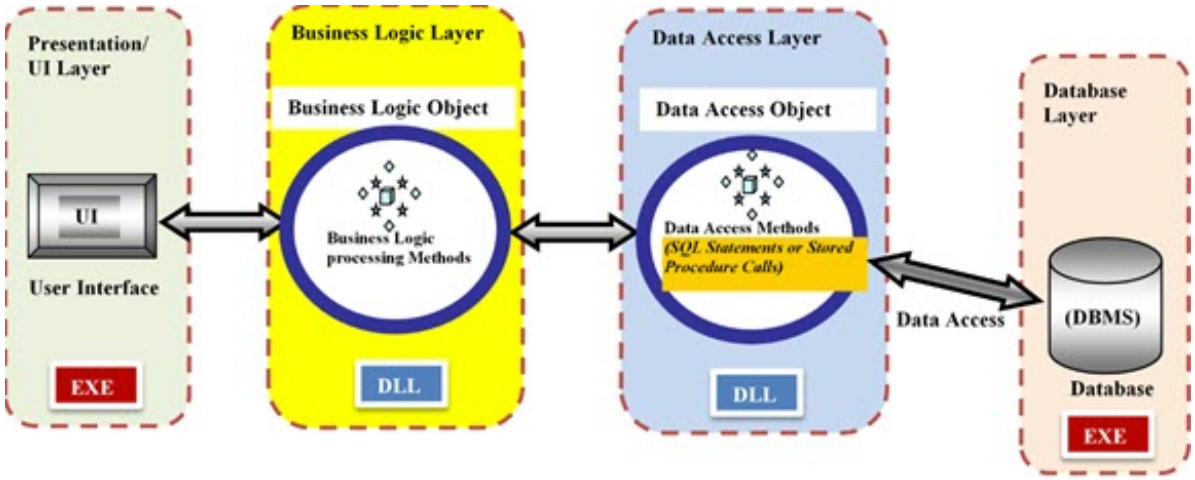
The following shows the N-tiered client/server. First the two executables (two-tiered) where the client executable communicates with the server through the network and vise a versa. Below that, is a picture of the Windows 4 tiered Client/Server used for the Windows forms for this backlog. Since it is a Windows application, the Presentation and User-Interface are in the same layer. The User interacts with this layer. That layer communicates only with the Business Classes/Object Layer (BOL). This layer contains all the classes that perform the processing, logic, rules, data accesss etc. The BOL further communicats with the Data Access Layer (DAL) to interact with the database layer. Hence, the DAL interacts with database storage and management which is where data is stored and managed. The layers allow for scalability, while the windows client allows for faster responsiveness since presentation and UI are in the same layer.



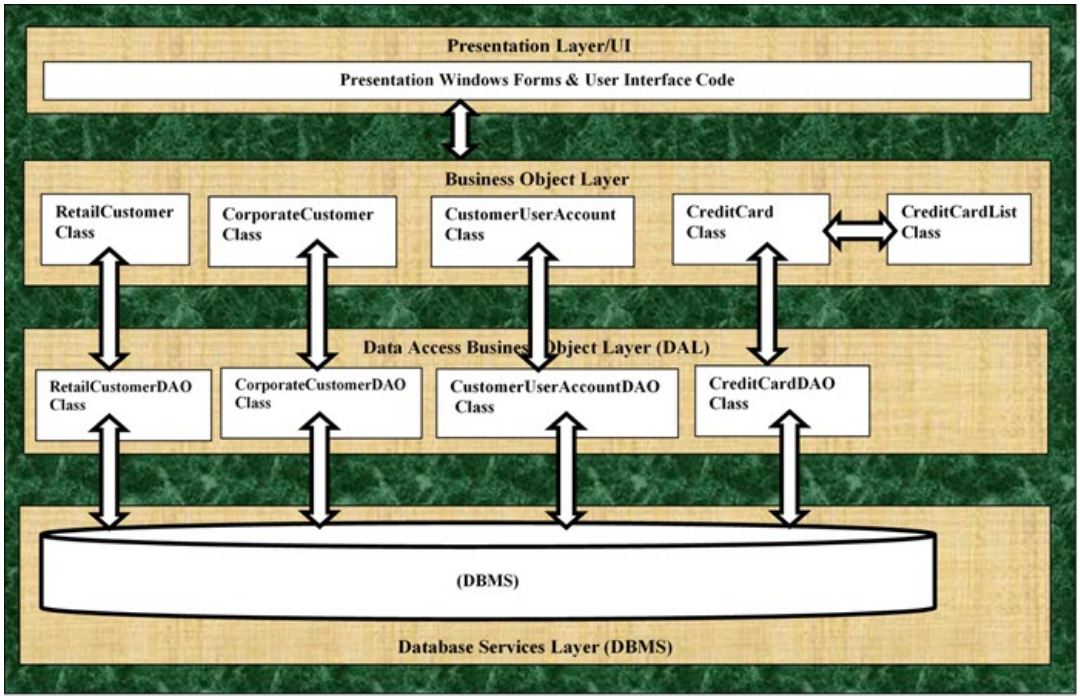
A second view that shows which projects are Executable Projects and which are Class Libraries (DLL):



A third view that shows in detail how EACH Class Object in each Architecture Layer interact with each other and the database:



A final view that shows in detail how EACH Class Object in each Architecture Layer interact with each other and the database:



PROJECT BACKLOG OF FEATURES & FUNCTIONALITIES

For this part of the project there was one backlog to be implemented, the Credit Card Management System. The following are the features and functionalities of all the project backlogs that require implementation.

Proposed Application Backlog Features & Functionality

Features & Functionality Overview

- ❑ The application is divided into the following **14 features & functionality or AGILE BACKLOG FEATURES**:

I. EZRental Rental Agency Point-of-Sales (POS) System:

- WINDOWS CLIENT-SIDE/FRONT-END – WINDOWS FORM APPLICATION INTERFACE SCREENS & features used by customer service employees via the Point-of-Sales computer machine in the stores to service customer requests or transactions such as:
  - Car Rental, Car Return, New Customer Registration & Search Customer Information, Customer Update, Customer Deletion, Customer Listing operations etc.
  - Note that the above functionalities apply to either a Retail Customer or Corporate Customer.
- This system is designed only to be used by customer service agents, maintenance service workers and other employees using the Windows Two-Tiered Client/Server Physical Architecture.

II. EZRental Internal Point-of-Sales (POS) System Back-end Database Design & Implementation to support the feature:

- DATABASE SERVER-SIDE/BACK-END – BACK-END DATABASE DESIGN & features (Tables, pre-populated tables, data, stored procedures, views, indices etc.,) to support each of these functionalities.

III. EZRental Internal Back-Office Vehicle Inventory Management System:

- A unique Back-end system meant for *employees* to perform bulk IN-MEMORY inventory processing or management tasks on rental vehicles such as adding vehicles to the system, searching for vehicles, updating vehicles etc. The idea is that the employee can perform all these features on their computer memory in one session without saving. When they are done with all transactions, save all processing to database in one bulk at the end of the session.
- This system is NOT meant for Point-of-Sales, but for the inventory management employees who need to search, add, remove etc., a large/bulk number of vehicles or employees during a session. This means the employee will perform many transactions during a session before permanently storing the data to database. This means that while the employee is executing a Back-End-Management task, all work is done in computer memory and only committed to database when the user exits the Back-End-Management system.
- These back-office features include:

- *Vehicle Management* – Allows inventory personnel and employees to bulk-manage Cars, SUVs, Mini-Vans, Cargo Vans to be *searched*, *added*, *removed*, *printed*, *listed etc*.

- These back-office features are not designed to be used by customers and not available via the Web and it's implemented using the Windows Two-Tiered Client/Server Physical Architecture only.

- WINDOWS CLIENT-SIDE/FRONT-END – WINDOWS FORM APPLICATION INTERFACE SCREENS & features required to implement the following features:

  - bulk-manage Cars, SUVs, Mini-Vans, Cargo Vans to be *searched*, *added*, *removed*, *printed*, *listed etc*.

IV. EZRental Internal Back-Office Vehicle Inventory Management System Back-end Database Design & Implementation to support the feature:

- DATABASE SERVER-SIDE/BACK-END – BACK-END DATABASE DESIGN & features (Tables, pre-populated tables, data, stored procedures, views, indices etc.,) to support each of these functionalities.

V. **EZRental Internal Back-Office Credit Card Management System:**

- The EZRental Credit Card Management System is a Back-end system meant for *The Credit Card Department Employees* to manage Credit Card Information. These uses can Search, Add, Edit & Delete credit card information in the database. Accomplishing this feature requires the back-end implementation of the Country and USState classes.

  - WINDOWS CLIENT-SIDE/FRONT-END – WINDOWS FORM APPLICATION INTERFACE SCREENS & features required to implement the following features:

    - Manage credit card records by performing the following actions: *search*, *add*, *edit, remove, print* & *print all credit cards*.

VI. EZRental Internal Back-Office Credit Card Management System Back-end Database Design & Implementation to support the feature:

- DATABASE SERVER-SIDE/BACK-END – BACK-END DATABASE DESIGN & features (Tables, pre-populated tables, data, stored procedures, views, indices etc.,) to support each of these functionalities.

VII. EZRental Internal Back-Office User Account Management System:

- The EZRental Customer & Employee User Account Management System is a Back-end system meant for *IT ADMINISTRATOR Employees* to manage both Employee & Customer USER ACCOUNTS.
- Employee User Accounts – These are the user accounts used by *IT Administrators*, *Customer Service Employees*, *back-office employees,* and any employee who qualifies for access to the system.
- Customer User Accounts – These are the user accounts used by Customer Service Employees, back-office employees and any employee who has access to the system.

- WINDOWS CLIENT-SIDE/FRONT-END – WINDOWS FORM APPLICATION INTERFACE SCREENS & features required to implement the following features:

  - Manage Employee User Accounts: *search*, *add*, *edit* & *remove*.
  - Manage Customer User Accounts: *search*, *add*, *edit* & *remove*

VIII. EZRental Internal Back-Office User Account Management System Back-end Database Design & Implementation to support the feature:

- DATABASE SERVER-SIDE/BACK-END – BACK-END DATABASE DESIGN & features (Tables, pre-populated tables, data, stored procedures, views, indices etc.,) to support each of these functionalities.

IX. Windows Form Application Security Authentication System:

- Proper security and authentication must be implemented to make sure only authorized employees can access the Point-0f-Sales & Back-End Management systems implemented using Windows Two-Tiered Client/Server Application.
- WINDOWS CLIENT-SIDE/FRONT-END – WINDOWS FORM APPLICATION INTERFACE SCREENS & features used by customer service employees to LOGIN to the system:

  - Employee Login Authentication functionality.

X. Windows Form Application Security Authentication System Back-end Database Design & Implementation to support the feature:

- DATABASE SERVER-SIDE/BACK-END – BACK-END DATABASE DESIGN & features (Tables, pre-populated tables, data, stored procedures, views, indices etc.,) to support each of these functionalities.

XI. EZRental External Web-Portal Point-of-Sales (POS) System:

- BROWSER CLIENT-SIDE/FRONT-END – Front-end WEB INTERFACE SCREENS & features used by customers via our web portal *EZRentalCar.com* to rent cars and manage their account online such as:

  - Reserve a car rental, register as a new customer, search/view their account information, update their account etc.

- This web portal *EZRental.com*, is a Web-based Three-Tiered Client/Server physical architecture used by customers via a browser.

XII. EZRental External Web-Portal Point-of-Sales (POS) System Back-end Database Design & Implementation to support the feature:

- DATABASE SERVER-SIDE/BACK-END – BACK-END DATABASE DESIGN & features (Tables, pre-populated tables, data, stored procedures, views, indices etc.,) to support each of these functionalities.

XIII. Customer Security Authentication System for Web Application:

- Security also needed for the Web-based Three-Tiered Client/Server Application *EZRental.com* portal.
- WEB SERVER – WEB SERVER-SIDE TECHNOLOGY FOR APPLICATION INTERFACE SCREENS & features used by customers via the Internet to LOGIN to the web portal:
  - Customer Login Authentication functionality.
- BROWSER CLIENT-SIDE/FRONT-END – Any CLIENT-SIDE SCRIPTING REQUIRED via JavaScript or other client/side technologies to support the web portal *EZRentalCar.com* .

XIV. Customer Security Authentication System for Web Application Back-end Database Design & Implementation to support the feature:

- DATABASE SERVER-SIDE/BACK-END – BACK-END DATABASE DESIGN & features (Tables, pre-populated tables, data, stored procedures, views, indices etc.,) to support each of these functionalities.

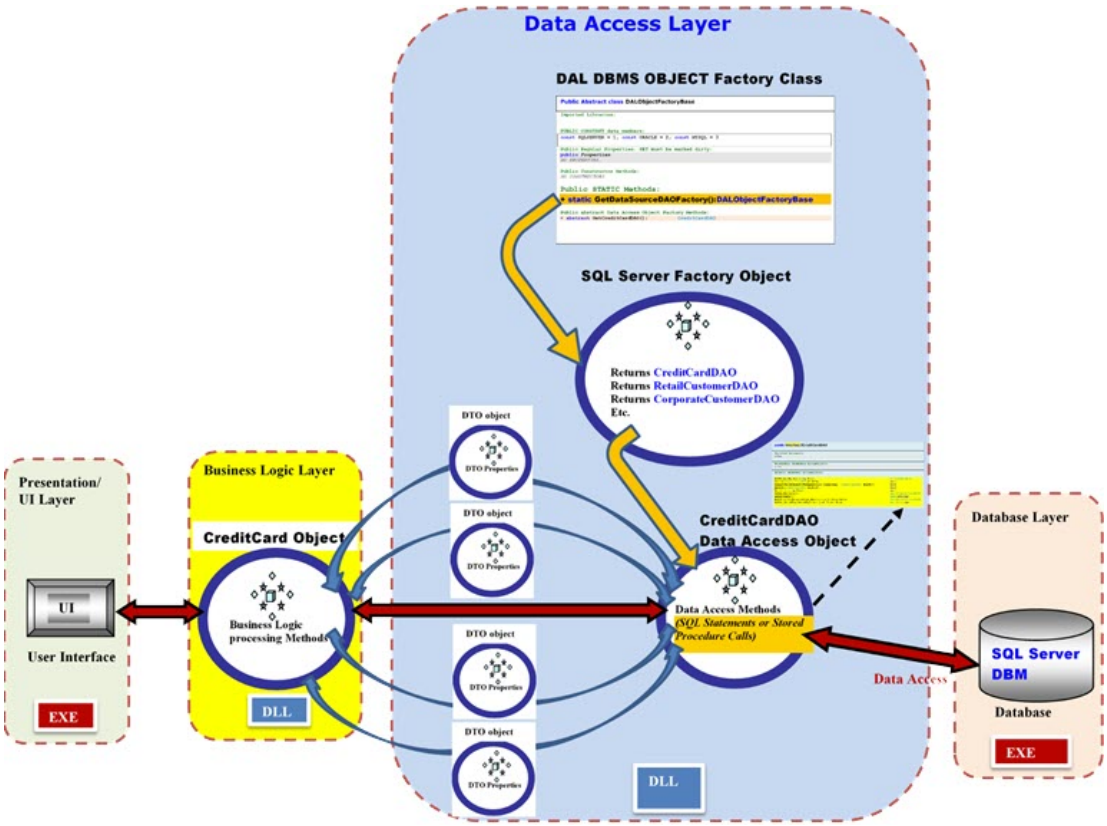
Project 2 SPRINT Backlog (Only Feature Implemented)

EZRental Internal Credit Card Back-end Management System

EZRental Internal Back-Office Credit Card Management System:

- The EZRental Credit Card Management System is a Back-end system meant for *The Credit Card Department Employees* to manage Credit Card Information. Users can Search, Add, Edit & Delete credit card information in the database. Accomplishing this feature requires the back-end implementation of the Country and USState classes.
  - WINDOWS CLIENT-SIDE/FRONT-END – WINDOWS FORM APPLICATION INTERFACE SCREENS & features required to implement the following features:
    - Manage credit card records by performing the following actions: *search*, *add*, *edit, remove, print* & *print all credit cards*.

Graphical Representation of the 4-Tiered Application Architecture used for the Credit Card Management System. In the data access layer, the Factory Class creates an object of which database will be used. This returns a CreditCardDAO which contains the method to communicate and query the database management system. The results are sent through DTO objects back to the business logic layer to then be sent to the presentation/UI layer.

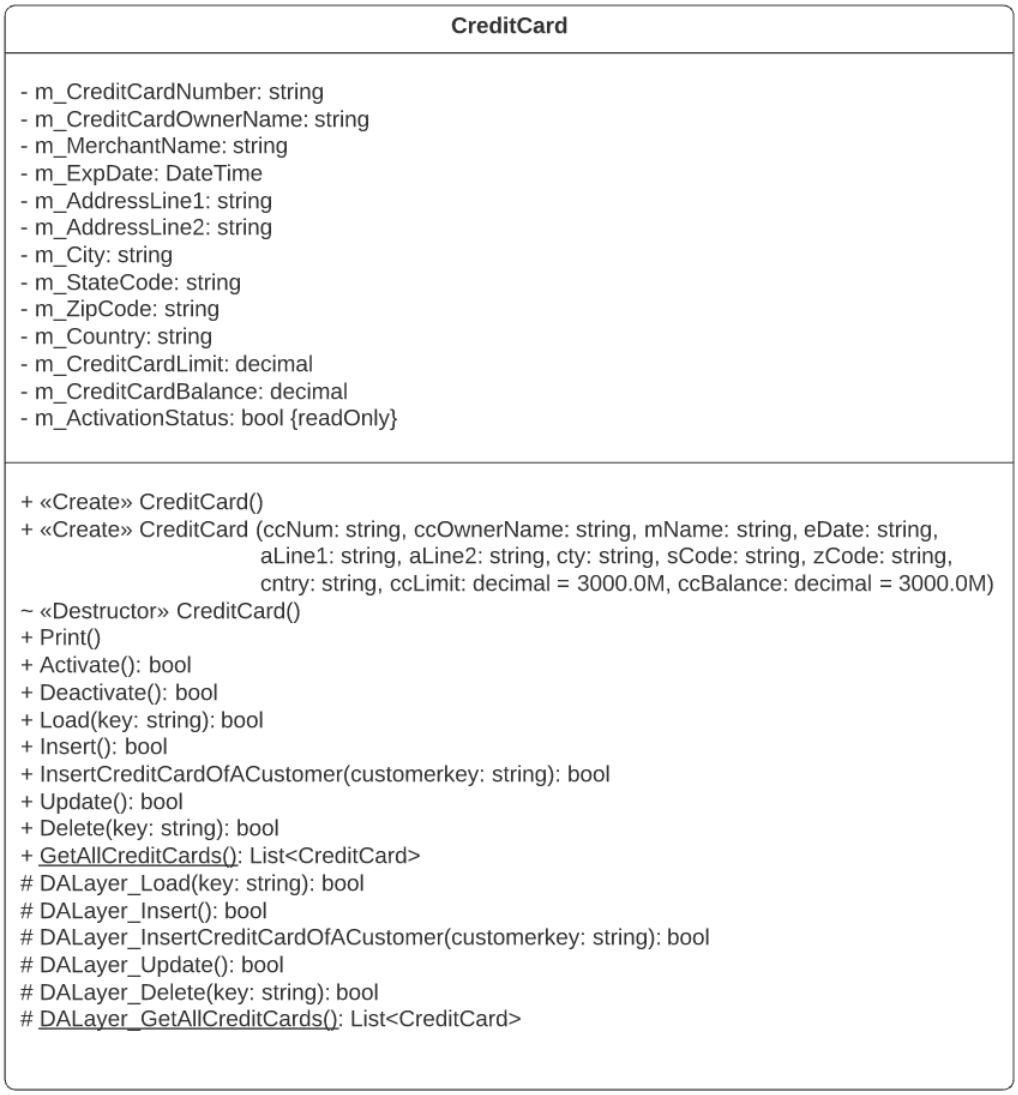


BUSINESS OBJECT LAYER CLASS ARCHITECTURE

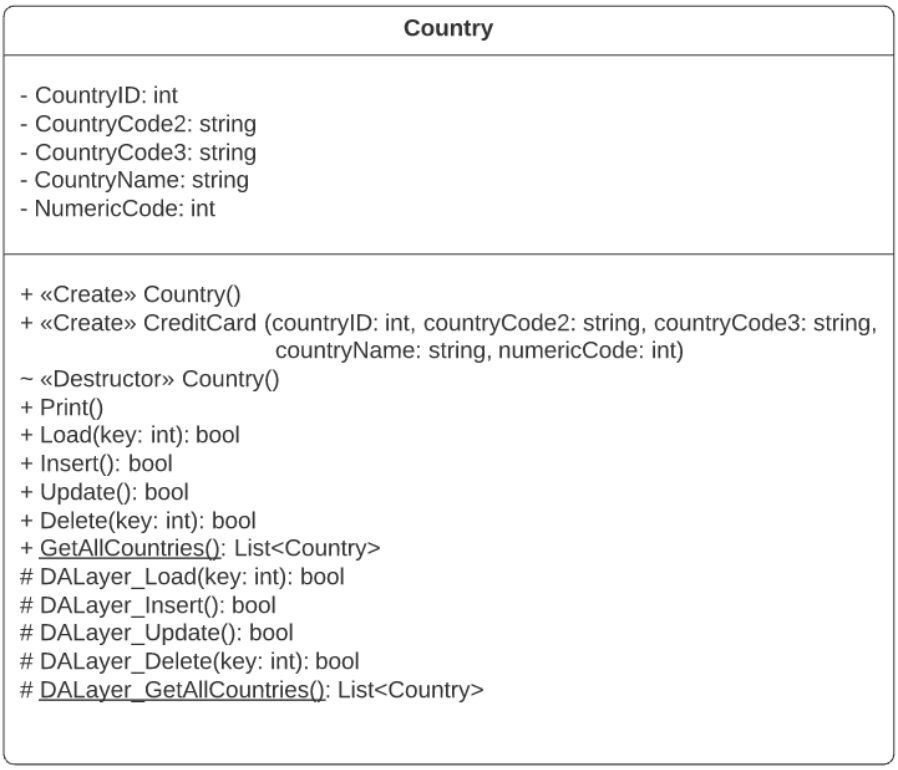
This section explains the Business Object Layer (BOL) of the N-tier Architecture.

- In this layer the business logic or feature implementation takes place. The BOL is a container or DLL/Class library that contains all the business classes that perform all the processing on behalf of the Presentation/User-Interface Layer.
- The classes in this layer process data returned from the Data Access Layer.

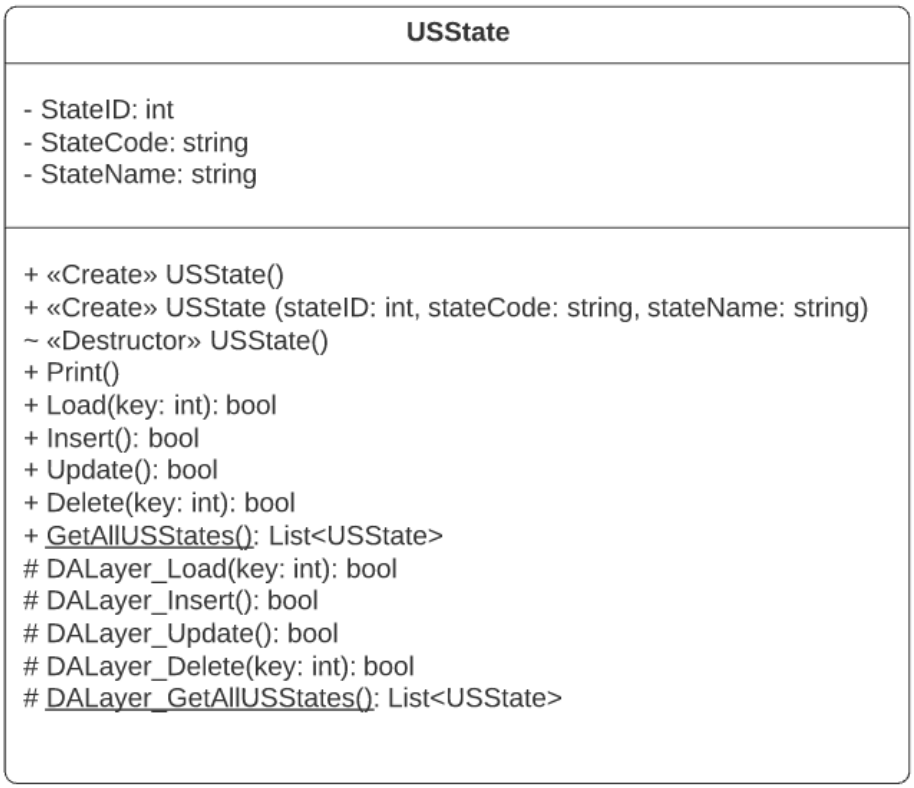
UML diagram for the CreditCard BOL class:



UML diagram for the Country BOL class:



UML diagram for the USState BOL class:

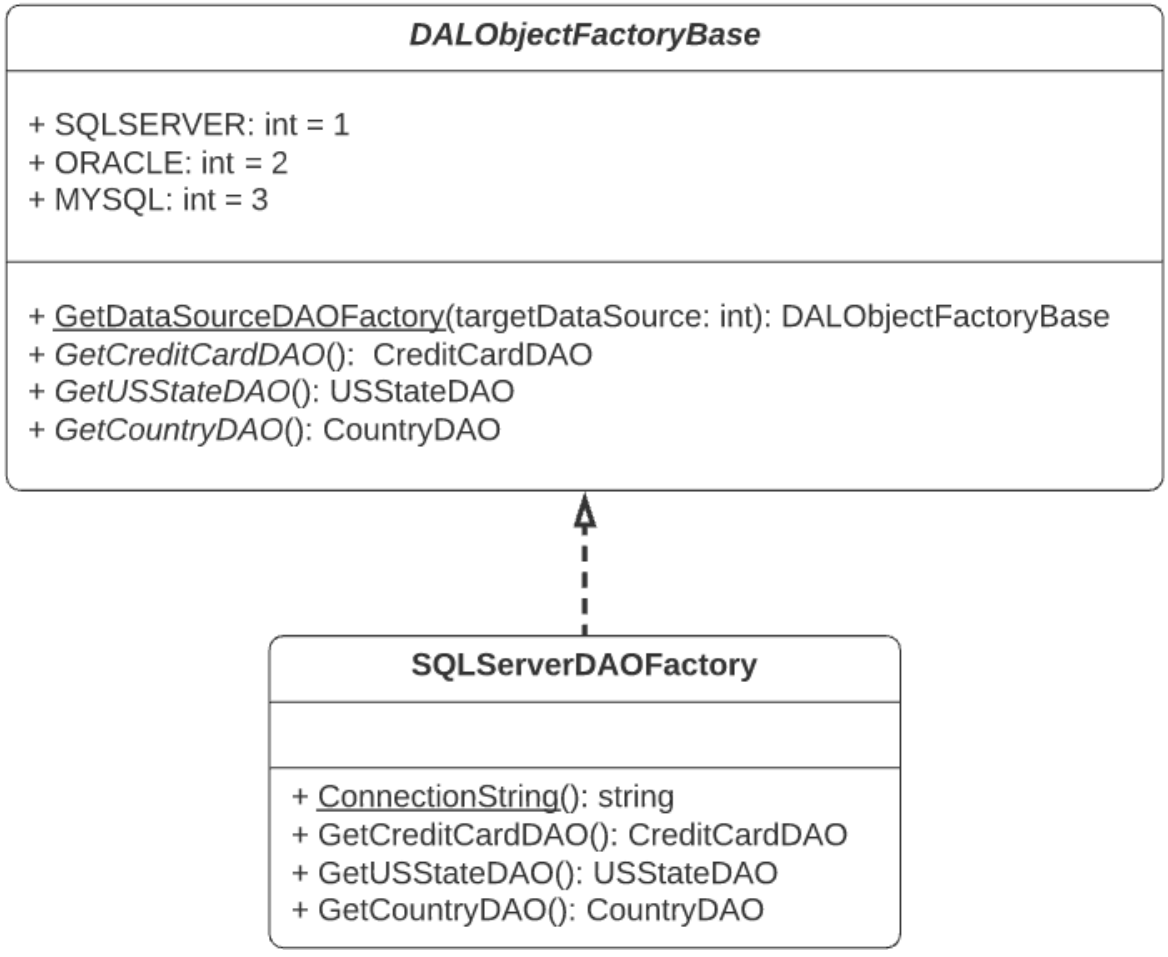


DATA ACCESS OBJECT LAYER CLASS ARCHITECTURE

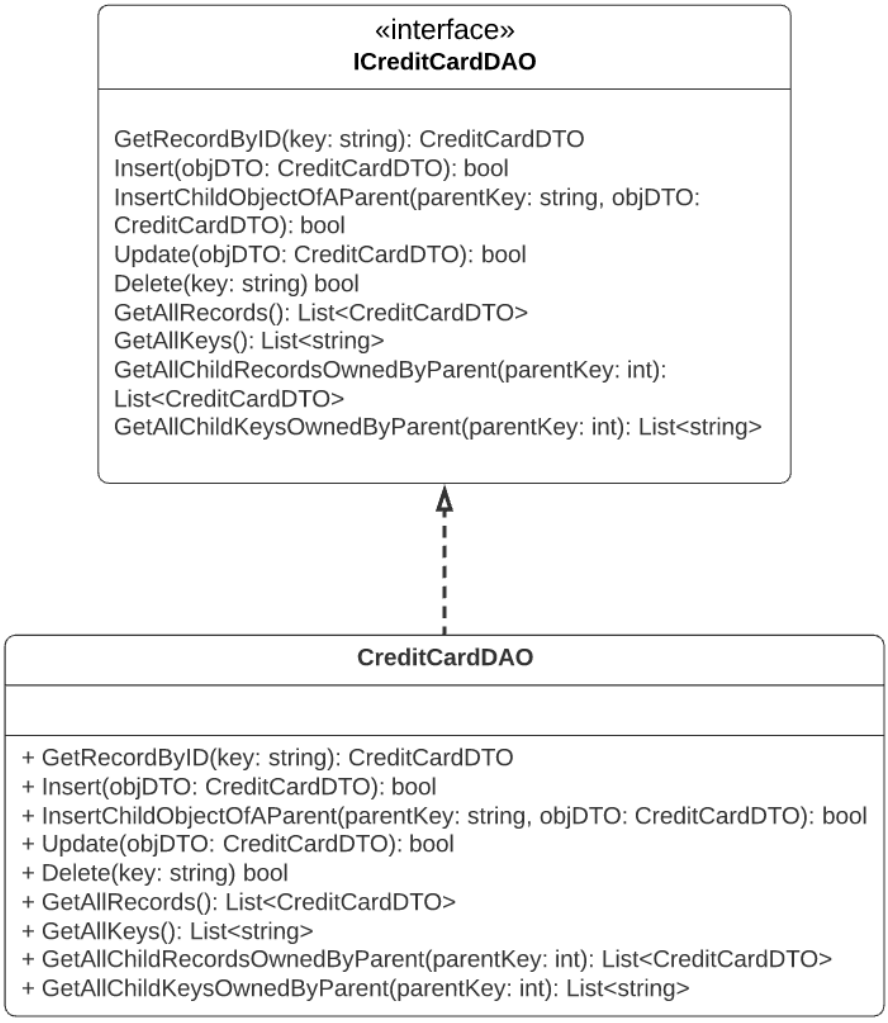
This section explains the Data Access Layer (DAL) used in the N-tiered architecture

- The job of the DAL is to perform all the data access on behalf of the Business Objects/Logic Layer.
- This is the layer that connects and engages the Database Management System, which in this case is Microsoft SQL Server. It contains all the data access classes that will perform all the database processing on behalf of the BOL.
- In our architecture, the DAL uses lightweight Data Transfer Object (DTO) classes to store and communicate data obtained from the database to the BOL.

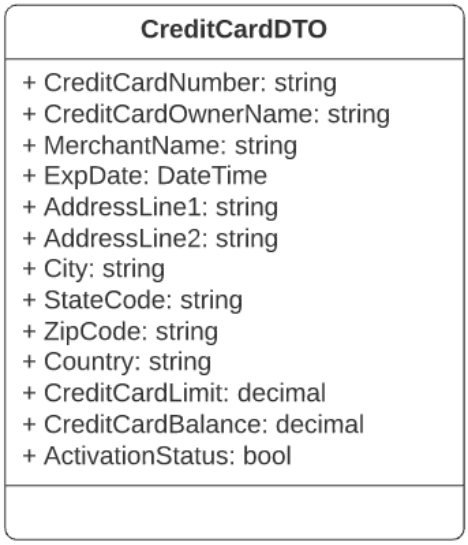
UML diagrams for DALObjectFactoryBase and SQLServerDAOFactory DAL classes:



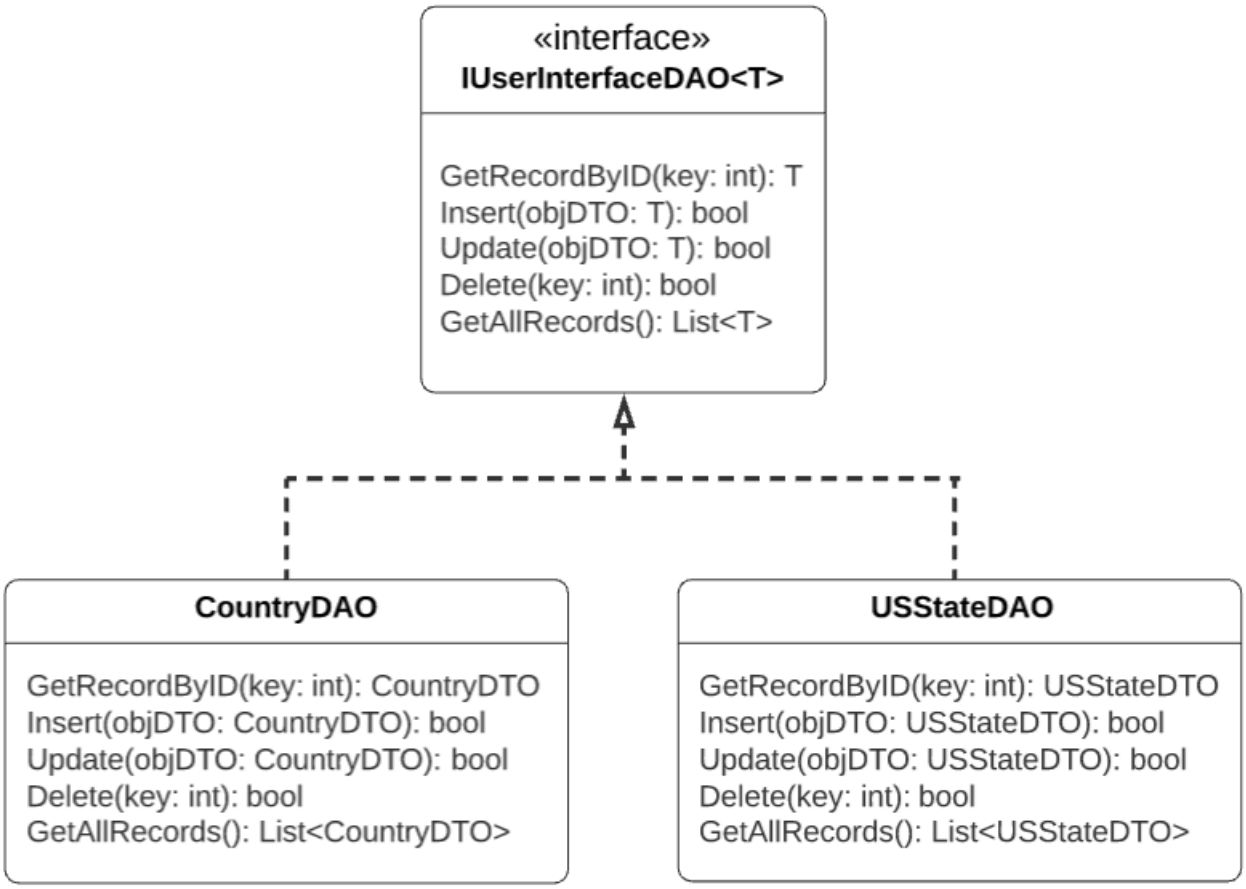
UML diagrams for ICreditCardDAO and CreditCardDAO DAL classes:



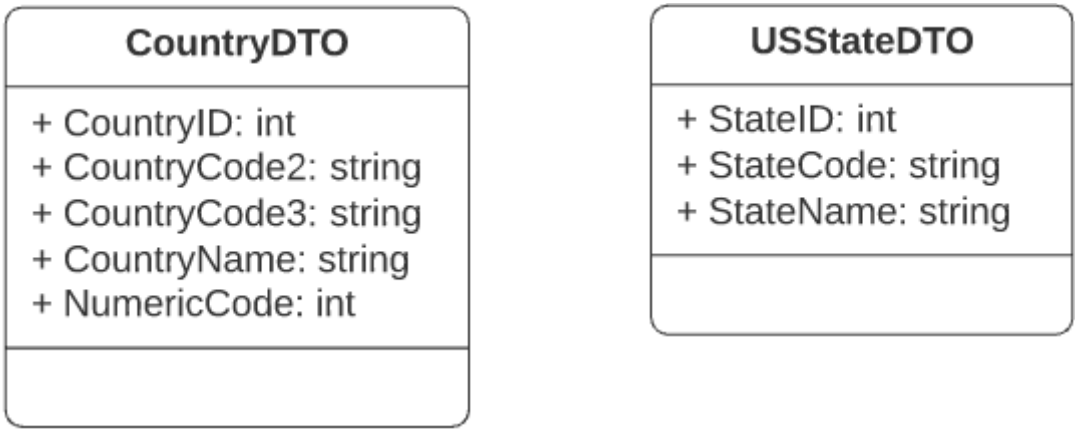
UML diagram for the CreditCardDTO DAL class:



UML diagrams for IUserInterfaceDAO<T>, CountryDAO and USStateDAO DAL classes:



UML diagrams for the CountryDTO and USStateDTO DAL class:

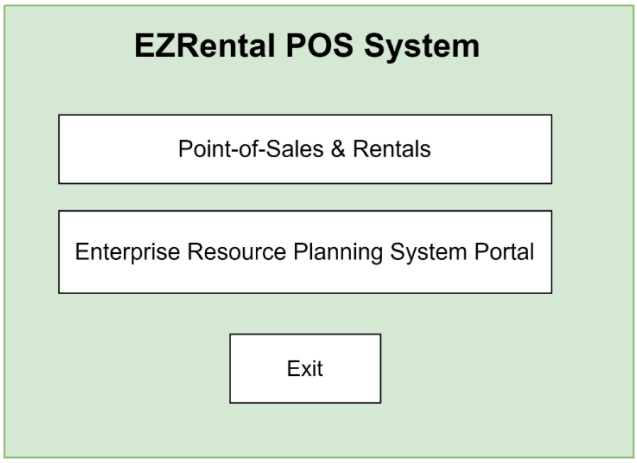


PRESENTATION/USER-INTERFACE LAYER DESIGN & IMPLEMENTATION

This section is divided into two parts. The first has the wireframes or outline of the graphical user-interface layouts and property tables used for the Windows Application. The second has the user-interface code implemented for the windows application and testing.

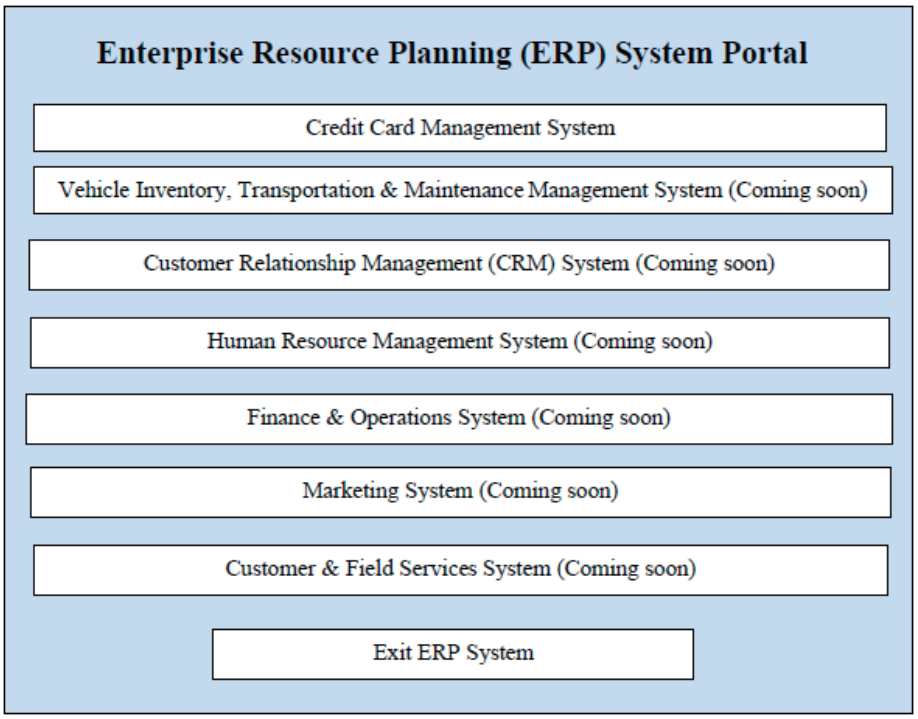
Part ONE: Wireframes and Property Tables

Main welcome GUI screen which is the entry portal that provides the features and functionalities of the application, including the Retail Point-of-Sales Screen, Enterprise Resource Management System, and Exit.



Object	Property	Value
Form	Form File Name Form Class Name Text	frmMainWelcomeForm.cs frmMainWeclcomeForm EZRental POS System
Label 1	Object Name Text Font	lblTitle EZRental POS System Bold font
Button1	Object Name Text	btnPOS Point-of-Sales && Rentals
Button2	Object Name Text	btnERP Enterprise Resource Planning System Portal
Button3	Object Name Text	btnExit Exit

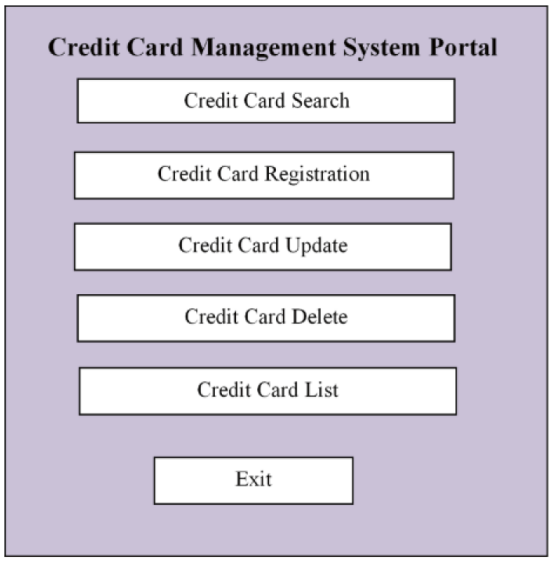
Enterprise Resource Management System Portal, the screen displayed when Enterprise Resource Planning System Portal button is clicked on the main welcome screen. The features and functionalities include the following: Credit Card Management, Product Inventory Management, Customer Relationship Management for Sales, Human Resource Management, Finance & Operations System, Marketing System, Customer Service & Field Service, and Exit (back to Main Screen).



Object	Property	Value
Form	Form File Name Form Class Name Text	frmERPSystemForm.cs frmERPSystemForm Enterprise Resource Planning (ERP) System Portal
Label 1	Object Name Text Font	lblTitle Enterprise Resource Management System Portal Bold font
Button1	Object Name Text	btncreditCardMS Credit Card Management System
Button2	Object Name Text	btnVehicleInventoryMS Vehicle Inventory, Transportation and Maintenance Management System (Coming Soon)
Button3	Object Name Text	btnCRM Customer Relationship Management (CRM) System (Coming Soon)
Button4	Object Name Text	btnHR Human Resource Management System (Coming Soon)
Button5	Object Name	btnFinanceOperationsMS

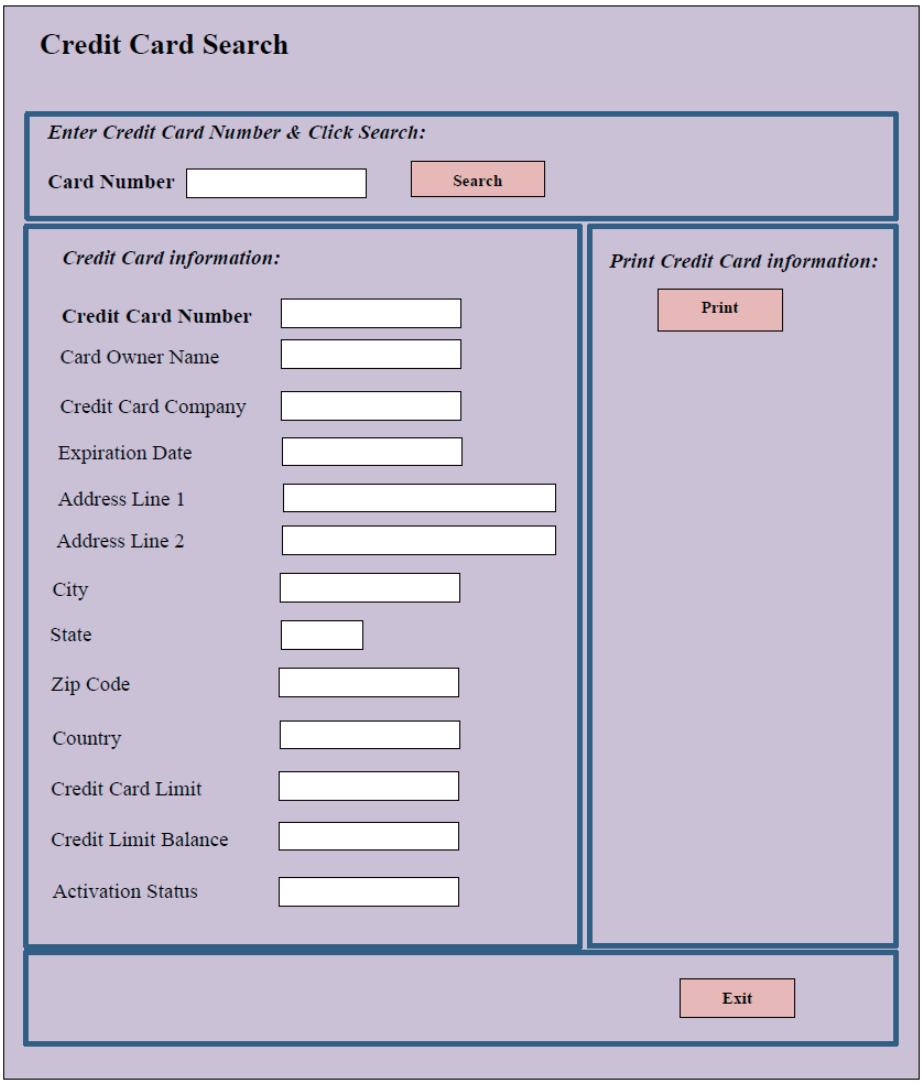
	Text	Finance & Operations Management System (Coming Soon)
Button6	Object Name Text	btnMarketingMs Marketing Management System (Coming Soon)
Button7	Object Name Text	btnCustomerFieldServicesMS Customer& Field Services Management System (Coming Soon)
Button8	ObjectName Text	btnExit Exit ERP System

Credit Card Management Screen, displayed when Credit Card Management button is selected from the ERP screen. The features and functionalities include the following: Credit Card Search, Credit Card Registration, Credit Card Update, Credit Card Deletion, and Exit (back to ERP screen) buttons.



Object	Property	Value
Form	Form File Name Form Class Name Text	frmCreditCardMSForm.cs frmCreditCardMSForm Credit Card Management System Portal
Label 1	Object Name Text Font	lblTitle Credit Card Management Screen Bold font
Button1	Object Name Text	btnSearch Credit Card Search
Button2	Object Name Text	btnRegistration Credit Card Registration
Button3	Object Name Text	btnUpdate Credit Card Update
Button4	Object Name Text	btnDelete Credit Card Deletion
Button5	Object Name Text	btnExit Exit

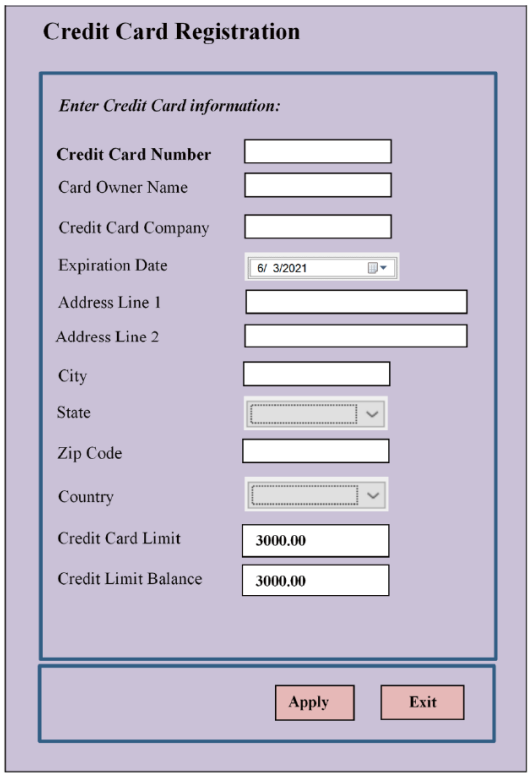
Credit Card Search, the screen displayed when Credit Card Search button is selected from the Credit Card Management Screen. The features and functionalities include the following: A card number textbox where a user will enter a credit card number, then do a search on the database for it by pressing the Search button. Moreover, the screen contains the necessary GUI controls to display the information returned from the database and an Exit button to go back to the Credit Card Management screen.



Object	Property	Value
Form 1	Form File Name Form Class Name Text	frmCreditCardSearchForm.cs frmCreditCardSearchForm Credit Card Search
Label 1	Object Name Text Font	lblTitle Credit Card Search Bold font
Label 2	Object Name Text Font	lblEnter Enter Credit Card Number & Click Search: Italic font
Label 3	Object Name Text Font	lblCardNumber Card Number Bold font
Textbox1	Name	txtCNumber
Button1	Object Name Text	btnSearch Search
Label 4	Object Name Text Font	lblInfo Credit Card Information: Italic font
Label 5	Object Name Text Font	lblCreditCardNumber Credit Card Number Bold font
Textbox2	Name ReadOnly	txtCreditCardNumber True
Label 6	Object Name Text	lblCardOwner Card Owner Name
Textbox3	Name ReadOnly	TxtCardOwner True
Label 7	Object Name Text	lblCreditCardCompany Credit Card Company
Textbox4	Name ReadOnly	txtCreditCardCompany True
Label 8	Object Name Text	lblExpDate Expiration Date
Textbox5	Name ReadOnly	txtExpDate True
Label 9	Object Name Text	lblAddressLine1 Address Line 1
Textbox6	Name ReadOnly	txtAddressLine1 True
Label 10	Object Name Text	lblAddressLine2 Address Line 2
Textbox7	Name ReadOnly	txtAddressLine2 True
Label 11	Object Name Text	lblCity City
Textbox8	Name ReadOnly	txtCity True
Label 12	Object Name Text	lblState State

Textbox9	Name ReadOnly	txtState True
Label 13	Object Name Text	lblZipCode Zip Code
Textbox10	Name ReadOnly	txtZipCode True
Label 14	Object Name Text	lblCountry Country
Textbox11	Name ReadOnly	txtCountry True
Label 15	Object Name Text	lblCreditCardBalance Credit Card Balance
Textbox12	Name ReadOnly	txtCreditCardBalance True
Label 16	Object Name Text	lblCreditCardLimit Credit Card Limit
Textbox12	Name ReadOnly	txtCreditCardLimit True
Label 17	Object Name Text	lblActivationStatus Activation Status
Textbox13	Name ReadOnly	txtActivationStatus True
Button2	Object Name Text	btnExit Exit
GroupBox1	Name	grpCardNumberSearch
GroupBox2	Name	grpCCInfo
Label 18	Object Name Name	lblPrintCreditCardInfo Print Credit Card Information
Button3	Object Name Name	btnPrint Print

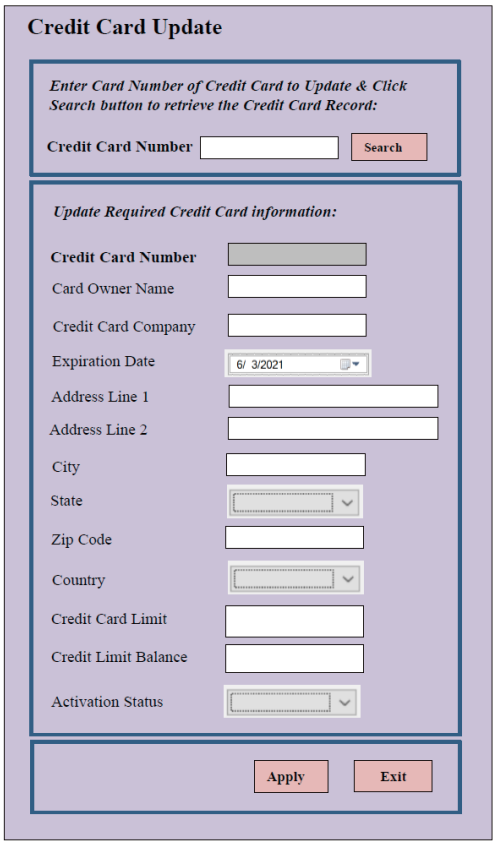
Credit Card Registration, displayed when the Credit Card Registration button is clicked from the Credit Card Management screen. The features and functionalities include the following: GUI Controls that enables the User to enter the Credit Card Information to be added to the database, an apply button to add the new credit card information entered in the GUI to be added to the database, and an exit button to go back to Credit Card Management screen.



Object	Property	Value
Form 1	Form File Name Form Class Name Text	frmCreditCardRegistrationForm.cs frmCreditCardRegistrationForm Credit Card Registration
Label 1	Object Name Text Font	lblTitle Credit Card Registration Bold font
Label 2	Object Name Text Font	lblEnter Enter Credit Card Information: Italic font
Label 3	Object Name Text Font	lblCreditCardNumber Credit Card Number Bold font
Textbox1	Name	txtCreditCardNumber
Label 4	Object Name Text	lblCardOwner Card Owner Name
Textbox2	Name	txtCardOwner
Label 5	Object Name Text	lblCreditCardCompany Credit Card Company

Textbox3	Name	txtCreditCardCompany
Label 6	Object Name Text	lblExpDate Expiration Date
DateTimePicker	Name Format	dtpExpDate Short
Label 7	Object Name Text	lblAddressLine1 Address Line 1
Textbox5	Name	txtAddressLine1
Label 8	Object Name Text	lblAddressLine2 Address Line 2
Textbox6	Name	txtAddressLine2
Label 9	Object Name Text	lblCity City
Textbox7	Name	txtCity
Label 10	Object Name Text	lblState State
ComboBox1	Name DropdownStyle	cbStateCode DropDownList
Label 11	Object Name Text	lblZipCode Zip Code
Textbox9	Name	txtZipCode
Label 12	Object Name Text	lblCountry Country
ComboBox2	Name DropdownStyle	cbCountry DropDownList
Label 13	Object Name Text	lblCreditCardBalance Credit Card Balance
Textbox11	Name	txtCreditCardBalance
Label 14	Object Name Text	lblCreditCardLimit Credit Card Limit
Textbox12	Name	txtCreditCardLimit
Label 15	Object Name Text	lblActivationStatus Activation Status
Textbox13	Name BackColor ReadOnly	txtActivationStatus WindowFrame True
Button1	Object Name Text	btnApply Apply
Button2	Object Name Text	btnExit Exit
GroupBox1	Name	grpEnterCCInfo

Credit Card Update, displayed when Credit Card Update button is selected from the Credit Card Management screen. The features and functionalities include the following: GUI Controls that enables the User to Search the database for a credit card information based on a Credit Card Number, returns the record, displays it on the screen and allows the user to update the credit card record in the database. Moreover, an apply button to update the new credit card information entered in the GUI to be added to the database, and an Exit button to go back to the Credit Card Management screen.



Object	Property	Value
Form 1	Form File Name Form Class Name Text	frmCreditCardUpdateForm.cs frmCreditCardUpdateForm Credit Card Update
Label 1	Object Name Text Font	lblTitle Credit Card Update Bold font
Label 2	Object Name Text Font	lblEnter Enter Credit Card Number of Credit Card to Update & Click Search button to return the Credit Card Record: Italic font
Label 3	Object Name Text Font	lblCardNumber CreditCard Number Bold font

Textbox1	Name	txtCNumber
Button1	Object Name Text	btnSearch Search
Label 4	Object Name Text Font	lblInfo Enter Credit Card information to Update: Italic font
Label 5	Object Name Text Font	lblCreditCardNumber Credit Card Number Bold font
Textbox2	Name BackColor ReadOnly	txtCreditCardNumber Button Shadow True
Label 6	Object Name Text	lblCardOwner Card Owner Name
Textbox3	Name	txtCardOwner
Label 7	Object Name Text	lblCreditCardCompany Credit Card Company
Textbox4	Name	txtCreditCardCompany
Label 8	Object Name Text	lblExpDate Expiration Date
DateTimePicker	Name Format	dtpExpDate Short
Label 9	Object Name Text	lblAddressLine1 Address Line 1
Textbox6	Name	txtAddressLine1
Label 10	Object Name Text	lblAddressLine2 Address Line 2
Textbox7	Name	txtAddressLine2
Label 11	Object Name Text	lblCity City
Textbox8	Name	txtCity
Label 12	Object Name Text	lblState State
ComboBox1	Name DropdownStyle	cbStateCode DropDownList
Label 13	Object Name Text	lblZipCode Zip Code
Textbox10	Name	txtZipCode
Label 14	Object Name Text	lblCountry Country
ComboBox2	Name DropdownStyle	cbCountry DropDownList
Label 15	Object Name Text	lblCreditCardBalance Credit Card Balance
Textbox12	Name	txtCreditCardBalance
Label 15	Object Name Text	lblCreditCardLimit Credit Card Limit
Textbox12	Name	txtCreditCardLimit
ComboBox3	Object Name	cbActivationStatus

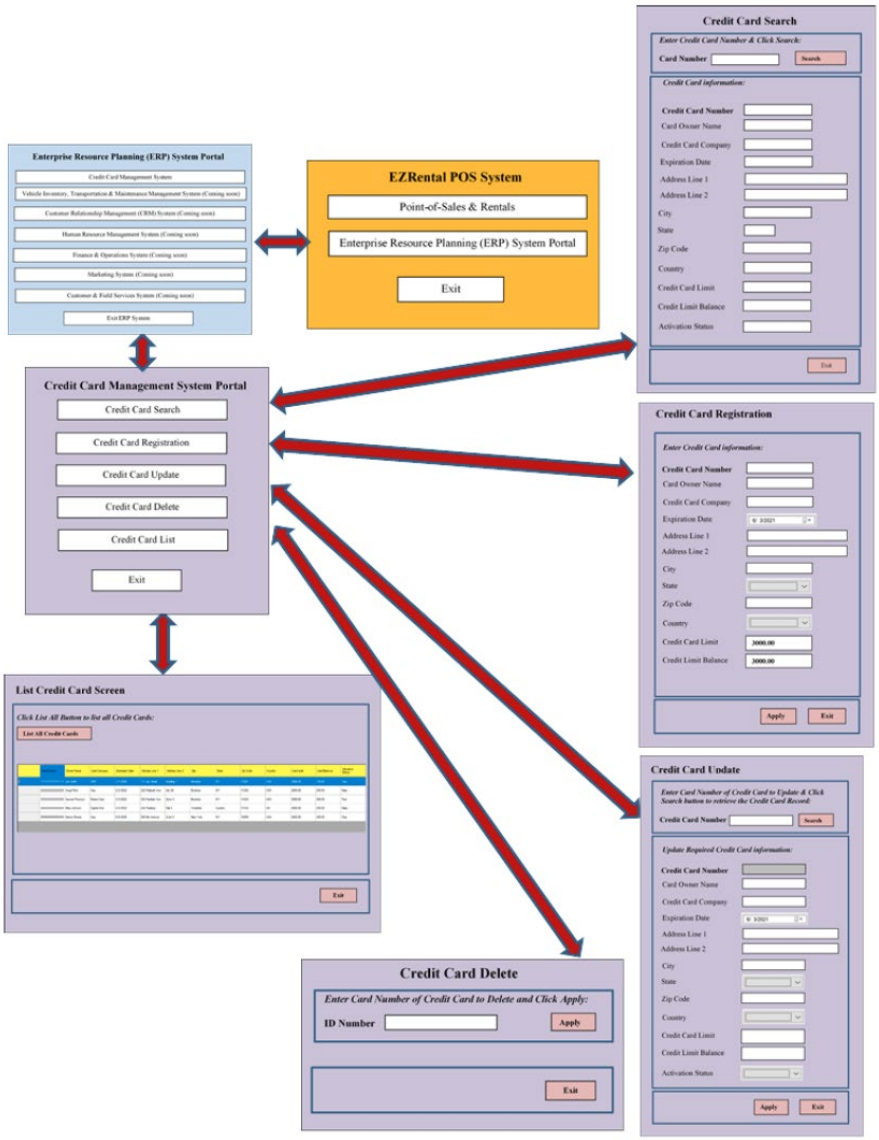
	DropdownStyle Items	DropDownList Collection (Activate, Deactivate)
ComboBox3	Name Back Color	txtActivationStatus Button Shadow
Button2	Object Name Text	btnApply Apply
Button3	Object Name Text	btnExit Exit
GroupBox1	Name	grpCardNumberSearch
GroupBox2	Name	grpCCUpdate

Credit Card Delete, the screen displayed when Credit Card Delete button is selected from the Credit Card Management screen. The features and functionalities are the following: GUI Controls that enables the user to delete the Credit Card Information/record from the database, an apply button to delete the credit card record from the database and an Exit button to go back to the Credit Card Management screen.

Object	Property	Value
Form 1	Form File Name Form Class Name Text	frmCreditCardDeleteForm.cs frmCreditCardDeleteForm Credit Card Delete
Label 1	Object Name Text Font	lblTitle Credit Card Delete Bold font
Label 2	Object Name Text Font	lblEnter Enter Card Number of Credit Card to Delete and Click Apply: Italic font
Label 3	Object Name Text Font	lblCNumber Card Number Bold font
Textbox1	Name	txtCNumber
Button1	Object Name Text	btnApply Apply
Button2	Object Name Text	btnExit Exit

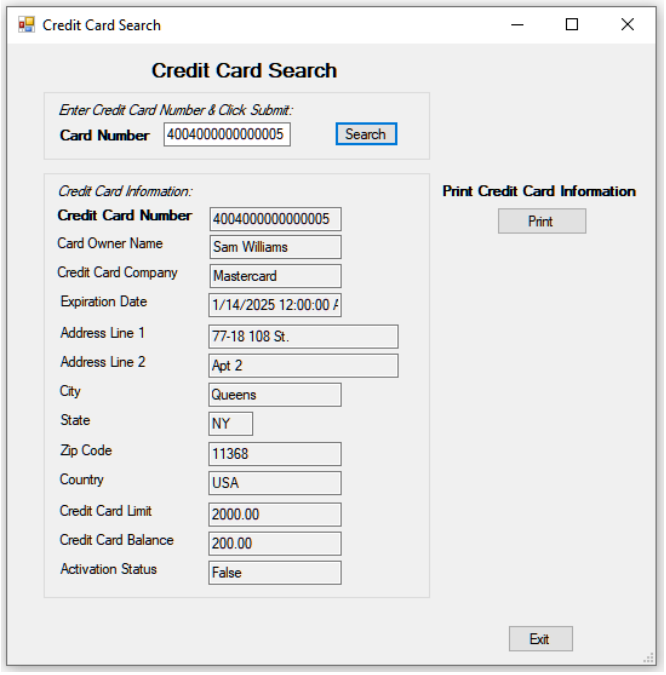
User Interface Code Implementation and Testing

Implemented code using C# and Visual Studio to program the navigation workflow of the windows application. Program starts at The EZRental POS System which has the Enterprise Resource (ERP) System Portal button that opens the Enterprise Resource Management System Portal and an exit button that exits the program. The Enterprise Resource Management System Portal has only the Credit Card Management button functioning with the rest being a future feature and an exit button that returns to EZRental POS System. The Credit Card Management Screen has four buttons that open the Credit Card Search, Credit Card Registration, Credit Card Update, Credit Card Deletion, Credit Card List, and exit back to ERP Portal. Each of these go back to the Credit Card management Screen with the exit button.



Implementation and Testing of the Credit Card Search form:

TEST: Search for a valid credit card number 4004000000000005




```
select * from CreditCard;
```

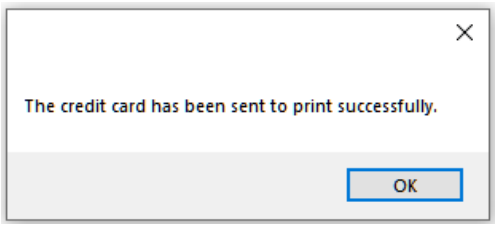
130 %

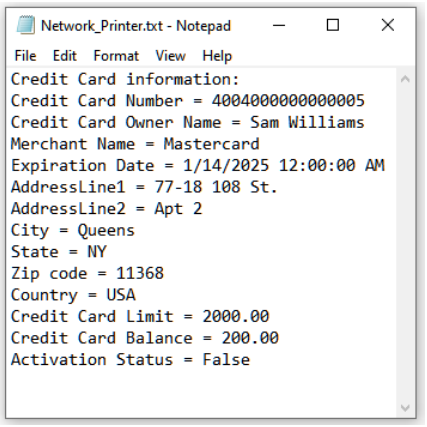
Results | Messages

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardLimit	CreditCardBalance	ActivationStatus
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	2000.00	200.00	1
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	1000.00	100.00	1
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	2000.00	200.00	1
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	1000.00	100.00	1
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	2000.00	200.00	0

Result: Searching for a valid credit card number by entering it in the Card Number textbox resulted in the successful retrieval (as seen in the database query above) and display of the given credit card through the population of all textboxes. This is the expected result.

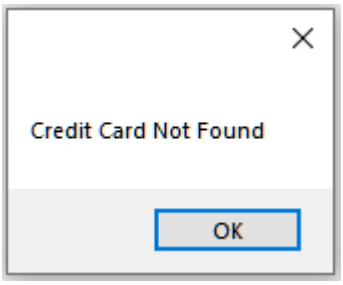
TEST: Print the searched credit card.

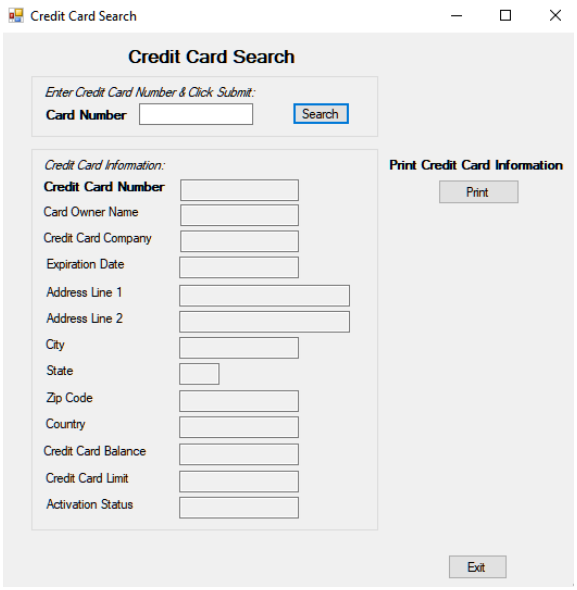




Result: Printing the credit card information that is currently displayed in the Credit Card Search form by clicking the Print button yields a message box indicating that printing was successful. The Network_Printer.txt that simulates printing is filled correctly with the information sent. This is the expected result.

TEST: Search for an invalid credit card number 12345

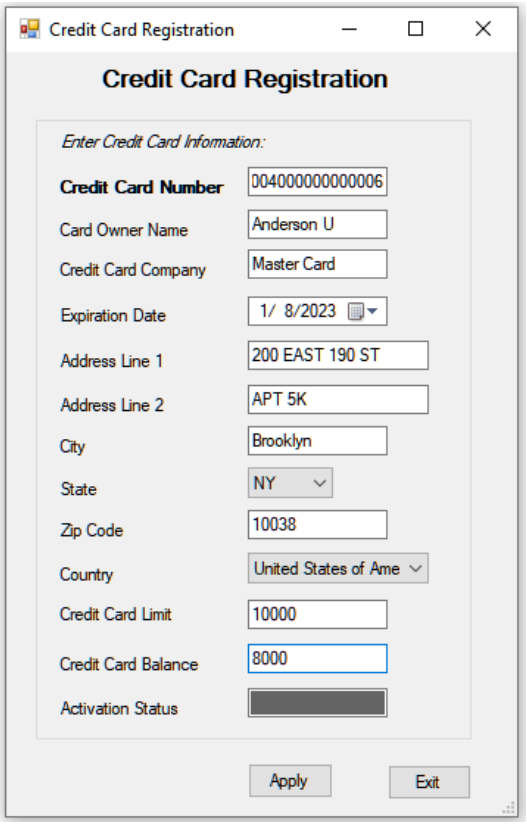


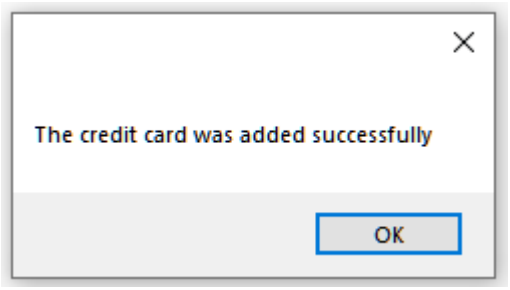


Result: Searching for an invalid credit card number leads to an error, as shown in the message box that appears. In addition, the Credit Card Search form is reset by emptying all text boxes. This is the expected result.

Implementation and Testing of the Credit Card Registration form:

TEST: Insert a new credit card with Credit Card Number 4004000000000006 and the information presented in the Credit Card Registration form below.






```
select * from CreditCard;
```

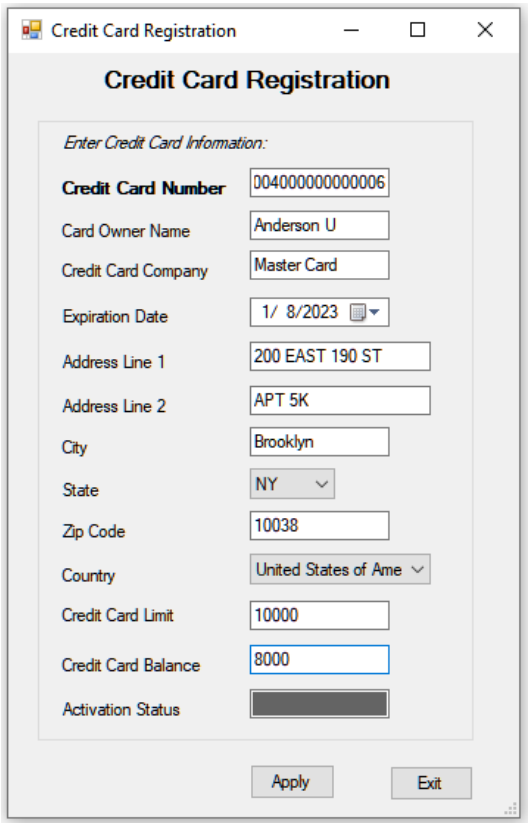
130 %

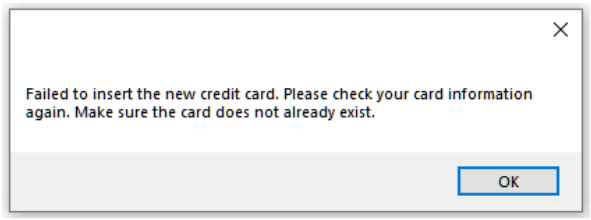
Results | Messages

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardLimit	CreditCardBalan
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	2000.00	200.00
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	1000.00	100.00
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	2000.00	200.00
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	1000.00	100.00
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	2000.00	200.00
6	4004000000000006	Anderson U	Master Card	2023-01-08	200 EAST 190 ST	APT 5K	Brooklyn	NY	10038	United States of America (the)	10000.00	8000.00

Result: Inserting a new credit card by pressing the Apply button after entering all the required information succeeded in inserting a new entry in the database. A message box appears telling the user his action was successful. This is the expected result.

TEST: Insert the same credit card that now exists in the database of number 4004000000000006:

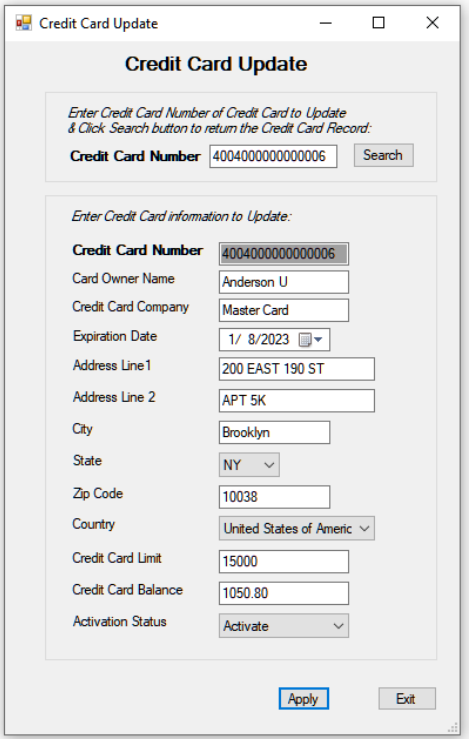


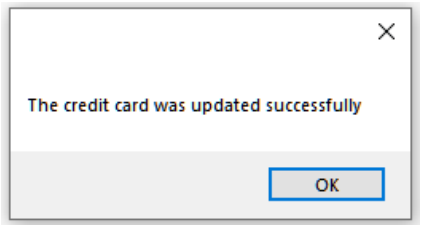


Result: The insertion of a credit card with the same number as an existing one fails. An error is displayed to the user in a message box. This is the expected result.

Implementation and Testing of the Credit Card Update form:

TEST: Update the record of the credit card with number 4004000000000006 by changing its Credit Card Limit and Credit Card Balance from 10000.00 and 8000.00 to 15000.00 and 1050.80 respectively:





Before

```
select * from CreditCard;
```

130 %

Results | Messages

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardLimit	CreditCardBalan
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	2000.00	200.00
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	1000.00	100.00
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	2000.00	200.00
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	1000.00	100.00
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	2000.00	200.00
6	4004000000000006	Anderson U	Master Card	2023-01-08	200 EAST 190 ST	APT 5K	Brooklyn	NY	10038	United States of America (the)	10000.00	8000.00

After

```
select * from CreditCard;
```

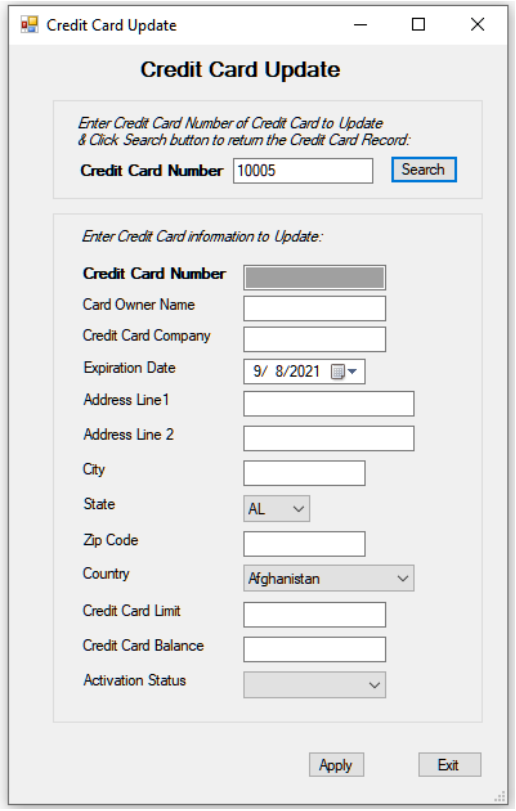
130 %

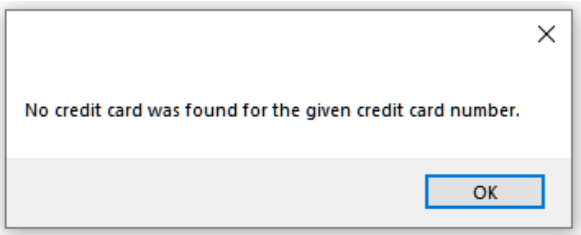
Results | Messages

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardLimit	CreditCardBalan
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	2000.00	200.00
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	1000.00	100.00
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	2000.00	200.00
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	1000.00	100.00
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	2000.00	200.00
6	4004000000000006	Anderson U	Master Card	2023-01-08	200 EAST 190 ST	APT 5K	Brooklyn	NY	10038	United States of America (the)	15000.00	1050.80

Result: The update of the Credit Card Limit and Credit Card Balance was processed successfully after clicking the Apply button, as shown in the message box that appears for the user. The Before and After images of the database detail the changes. This is the expected result.

TEST: Search for a credit card with number 10005 in the Credit Card Update form, which does not exist in the database:

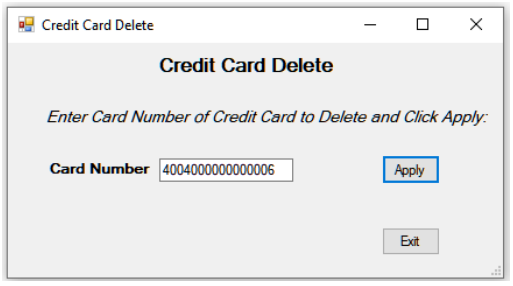


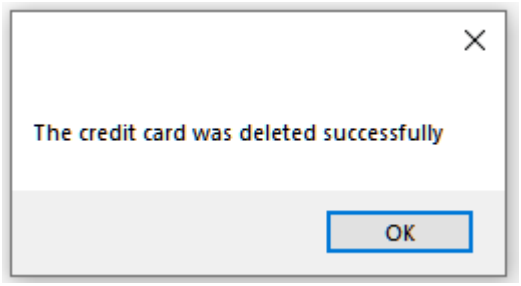


Result: The search function of the Credit Card Update form will return an error in a message box for the user if the credit card is not found in the database, as depicted above. This is the expected result.

Implementation and testing of the Credit Card Delete form:

TEST: Delete a credit card of number 4004000000000006:





Before

```
select * from CreditCard;
```

130 % Results Messages

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardLimit	CreditCardBalan
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	2000.00	200.00
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	1000.00	100.00
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	2000.00	200.00
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	1000.00	100.00
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	2000.00	200.00
6	4004000000000006	Anderson U	Master Card	2023-01-08	200 EAST 190 ST	APT 5K	Brooklyn	NY	10038	United States of America (the)	15000.00	1050.80

After

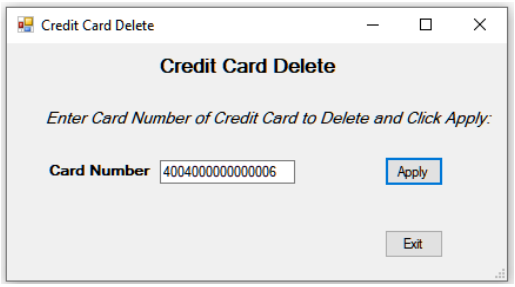
```
select * from CreditCard;
```

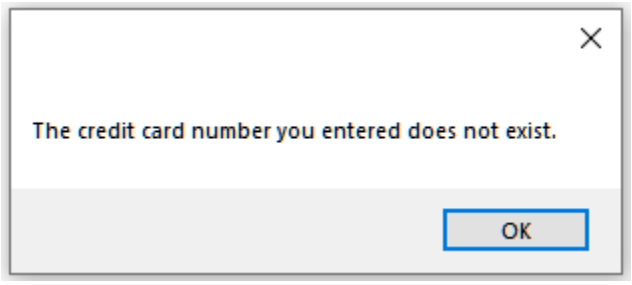
130 % Results Messages

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardLimit	CreditCardBalance	ActivationStatus
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	2000.00	200.00	1
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	1000.00	100.00	1
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	2000.00	200.00	1
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	1000.00	100.00	1
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	2000.00	200.00	0

Result: The deletion of the credit card was successful, as described in the message box shown to the user after they enter the Card Number and click the Apply button. The before and after images of the database show the successful removal of card number 4004000000000006. This is the expected result.

TEST: Delete a credit card that does not exist in the database.





Result: The deletion of the credit card failed, as described in the message box shown to the user.

Implementation and testing of the Credit Card List screen:

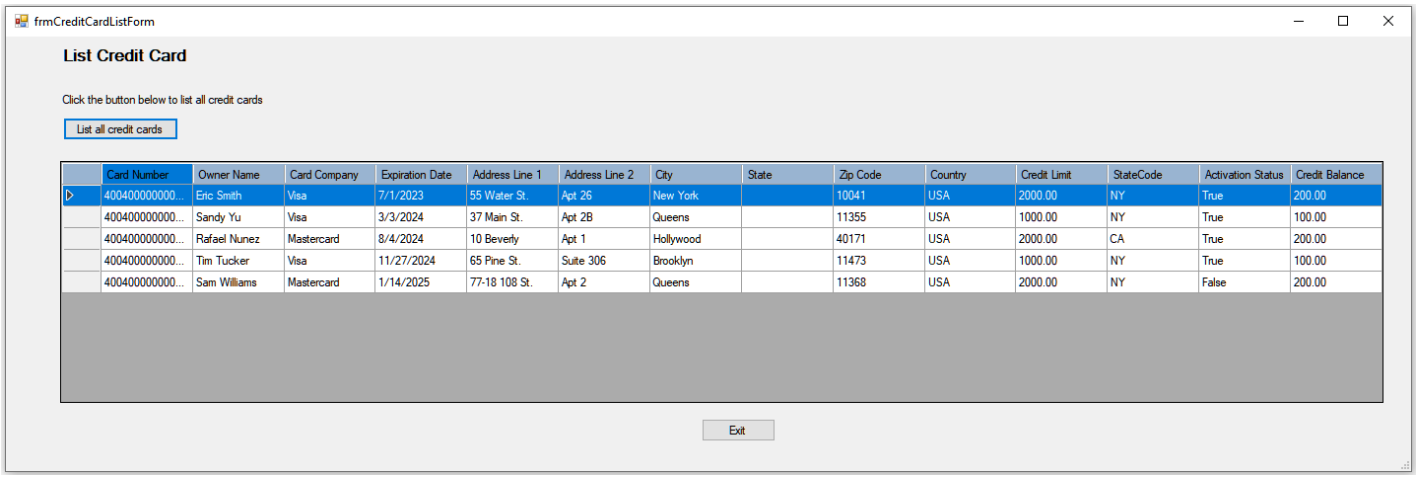
TEST: List all credit cards by pressing the button “List all credit cards”:

```
select * from CreditCard;
```

130 %

Results | Messages

	CreditCardNumber	OwnerName	MerchantName	ExpDate	AddressLine1	AddressLine2	City	StateCode	ZipCode	Country	CreditCardLimit	CreditCardBalance	ActivationStatus
1	4004000000000001	Eric Smith	Visa	2023-07-01	55 Water St.	Apt 26	New York	NY	10041	USA	2000.00	200.00	1
2	4004000000000002	Sandy Yu	Visa	2024-03-03	37 Main St.	Apt 2B	Queens	NY	11355	USA	1000.00	100.00	1
3	4004000000000003	Rafael Nunez	Mastercard	2024-08-04	10 Beverly	Apt 1	Hollywood	CA	40171	USA	2000.00	200.00	1
4	4004000000000004	Tim Tucker	Visa	2024-11-27	65 Pine St.	Suite 306	Brooklyn	NY	11473	USA	1000.00	100.00	1
5	4004000000000005	Sam Williams	Mastercard	2025-01-14	77-18 108 St.	Apt 2	Queens	NY	11368	USA	2000.00	200.00	0



Result: The credit cards in the database are listed successfully.

CONCLUSION

A summary of the necessary steps taken to develop and implement the project according to specifications.

- Designed and implemented a Windows 4-Tiered client/server application with a Presentation/User-Interface layer, Business Object Layer, Data Access Layer and a database (implemented in Project 1)
- Designed and implemented the business logic in the classes CreditCard, Country and USState.
- Designed and implemented all the data access layer classes for the CreditCard, Country, and USState features required to connect to the database, query that database, and transfer data to the business layer using data transfer objects.
- Designed the UML class diagrams for the DBO and DAL.
- Designed and implemented the Main, Enterprise Resource planning, Credit Card management, Credit Card Search, Register, Update, Delete, and List forms.
- Tested all the implemented forms
- Programmed the event handlers required to use the form to search, register, update, delete, and list credit cards from the database.