CMPE 332 – Database Management Systems

K-Town Car Share

Phase 1 – Database Design and Implementation

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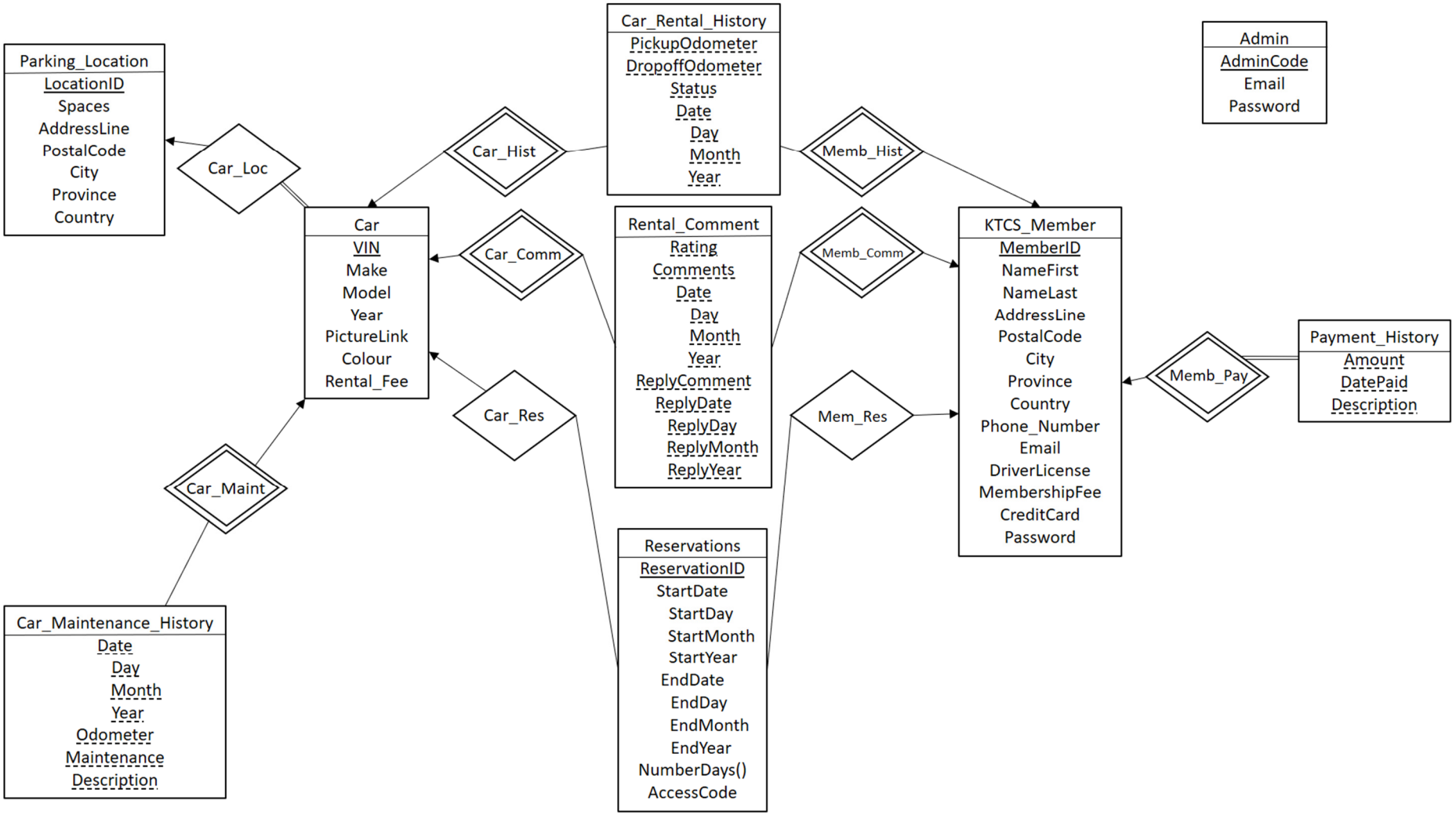
Assumptions

- Each member will pay for the entire month during which they sign up, regardless of signup day (so Jan 1 and Jan 29 signups are charged for all of January).
- Each member will pay for car / reservation as soon as they book the car.
- There are no cancellations / refunds.
- A car is available for the day unless it has been reserved.
- A car reserved for a day begins at 12:00 am on that day and ends 11:59 pm on the end reserved day.
- Members cannot reserve for than 14 days in advance.
- Every car is in its specified location at the start of each rental.
- Parking location is never over capacity → a location starts under or at max capacity, and is never exceeded because all cars returned to same location.
- The user fills out gas amount as part of the pickup / drop-off form.
- Replies to comments are limited to one reply and only an admin can reply.
- Car rental history is only created when a car gets rented.
- Car maintenance history is only created when a car gets sent in for maintenance.
- Assume only one picture per car, one phone number per member, one email per member, one Credit Card per member.
- Each time maintenance is performed, only one type of maintenance can be displayed.
- No Username is required – email will be used instead.

ER Schema


Parking_Location
LocationID
Spaces
AddressLine
PostalCode
City
Province
Country
Car_Loc
Car_Rental_History
PickupOdometer
DropoffOdometer
Status
Date
Day
Month
Year
Car_Hist
Memb_Hist
Admin
AdminCode
Email
Password
Car
VIN
Make
Model
Year
PictureLink
Colour
Rental_Fee
Car_Comm
Rental_Comment
Rating
Comments
Date
Day
Month
Year
ReplyComment
ReplyDate
ReplyDay
ReplyMonth
ReplyYear
Memb_Comm
KTCS_Member
MemberID
NameFirst
NameLast
AddressLine
PostalCode
City
Province
Country
Phone_Number
Email
DriverLicense
MembershipFee
CreditCard
Password
Payment_History
Amount
DatePaid
Description
Memb_Pay
Car_Res
Mem_Res
Car_Maint
Reservations
ReservationID
StartDate
StartDay
StartMonth
StartYear
EndDate
EndDay
EndMonth
EndYear
NumberDays()
AccessCode
Car_Maintenance_History
Date
Day
Month
Year
Odometer
Maintenance
Description

ER Explanation

To optimize the database system, the following decisions were made. These include the use of weak-entity sets and various cardinality and participation modes. The purpose of using weak-entity sets and relationships is due to the close association seen between the objects. The weak entity set object (i.e. Car_Rental_History) is dependent and relies on the strong entity, as it cannot exist without the Car entity set. As can be seen in the Relational Schema section, in the weak-entity relationships, the primary key of the strong entity becomes a primary key of the weak-entity set.

The ER schema above uses a variety of cardinality modes such as one-to-many/many-to-one relationships. As an example, the Reservations table has a many to one relationship with the Car and KTCS_Member objects. This is because you can have many Reservation objects for one car and member. The many to one relationship is represented in the Relational Schema seen below by adding the primary key of the one side (i.e. The Car and KTCS Member) as attributes to the many side (i.e. Reservations). Finally, total participation is used solely for the Payment_History to KTCS Member relationship. This is because one of the assumptions the team made is that as soon as KTCS Member is created there will be at least one Payment_History object created which contains the monthly fee to be charged. Payment_History objects will also be created whenever a user reserves a car.

Within the Admin table, it was decided to make it a dedicated table that is not in a relationship with anything else. This is because the Admin will only contain 3 attributes: the user name, password and admin code that is generated for the admin. Admins will sign into the website by providing all 3 fields. Admins do not have a name or any personal information associated with them and because of this the Admin table does not need to have an ISA relationship with the KTCS_Member.

Another feature of the ER diagram seen above is the use of the derived variable ‘NumberDays()’ for the Reservations table. The purpose of this derived variable is to compute the number of days that the user will be renting the car. This will be done by getting the ‘StartDate’ and ‘EndDate’ and subtracting them to get the number of days.

Relational Schema

$Parking\_Location(\underline{LocationID}, AddressLine, PostalCode, Province, City, Country, Spaces)$

$Car(\underline{VIN}, Make, Model, Year, LocationID, Colour, PictureLink, RentalFee)$

$Car\_Rental\_History(\underline{VIN}, \underline{MemberID}, \underline{PickupOdometer}, \underline{DropoffOdometer}, \underline{Status}, \underline{Date})$

$Car\_Maintenance\_History(\underline{VIN}, \underline{Date}, \underline{Odometer}, \underline{Maintenance}, \underline{Description})$

$Rental\_Comment(\underline{VIN}, \underline{MemberID}, \underline{Rating}, \underline{Comment}, \underline{Date}, \underline{ReplyComment}, \underline{ReplyDate})$

$Reservations(\underline{ReservationID}, MemberID, VIN, StartDate, EndDate, Access\_Code)$

$KTCS\_Member(\underline{MemberID}, NameFirst, NameLast, AddressLine, PostalCode, Province, City, Country, PhoneNumber, Email, DriverLicense, MembershipFee, Password, CreditCard)$

$Payment\_History(\underline{MemberID}, \underline{Amount}, \underline{Date}, \underline{Description})$

$Admin(\underline{AdminCode}, Email, Password)$

Relational Schema Explanation

Based on the ER diagram, the relational schema was created (as seen above). In terms of handling the one to many/many to one relationships, the primary key of the one side was added as an attribute to the many side. This created a foreign key relationship. As an example, the Parking_Location shares a one to many relationship with Car so Parking_Location's primary key of LocationID was added as an attribute in Car.

Another note with the relational schema is the various optimizations the team made in order to make the schema more efficient. In the ER diagram the dates for the various objects (ie. Car_Rental_History) were a composite value comprised of day, month and year. In SQL there is a predefined date type that takes care of the various aspects of the date. Thus, in the relational schema there is no need to have day, month and year as it is just replaced by a date object.

In addition, in the ER schema there was a derived variable 'NumberDays()', but the derived variable is not present in the relational schema or the SQL. This is because the number of days the user is reserving the car for will be computed by querying the StartDate and EndDate and subtracting them.

In terms of constraints of various variables, this is not seen in the Relational Schema but it is present in the SQL table create statements found in the following section. Constraints were added for Rating, Maintenance and Status. The 'Rating' attribute constraint ensured that Rating would only be an integer from 1-4. The 'Maintenance' attribute constraints are that it can only take on the values of either 'scheduled', 'repair' or 'body work'. Finally, the 'Status' attribute constraints are that it can only take on the values of either 'normal', 'damaged', or 'not running'.

SQL Tables with Sample Data

Parking Location

```
CREATE TABLE parking_location (
  LocationID int(11) NOT NULL,
  AddressLine varchar(40) NOT NULL,
  PostalCode varchar(20) NOT NULL,
  Province varchar(30) NOT NULL,
  City varchar(40) NOT NULL,
  Country varchar(40) NOT NULL,
  Spaces int(11) NOT NULL,
  primary key (LocationID));
```

LocationID	AddressLine	PostalCode	Province	City	Country	Spaces
24	88 Union Street	K1Z 9U7	Ontario	Kingston	Canada	55
86	230 Johnson Lane	K1Z 9U7	Ontario	Kingston	Canada	25
92	69 Database Lane	K1Z 8L0	Ontario	Toronto	Canada	40

Car

```
CREATE TABLE car (
  VIN int(11) NOT NULL,
  Make varchar(15) NOT NULL,
  Model varchar(15) NOT NULL,
  Year int(11) NOT NULL,
  LocationID int(11) NOT NULL,
  Colour varchar(10) NOT NULL,
  PictureLink varchar(50) NOT NULL,
  RentalFee decimal(10,2) NOT NULL,
  primary key (VIN),
  foreign key (LocationID) references Parking_Location(LocationID));
```

VIN	Make	Model	Year	LocationID	Colour	PictureLink	RentalFee
20140294	Toyota	Corolla	2014	86	Green	welovetoyota.com/2018	30.20
20140295	Porsche	Cayenne	2014	24	Blue	porsche.com/2017	42.40
20140296	Tesla	Model 3	2017	92	Red	tesla.com/model3	20.00

Car_Rental_History

```
CREATE TABLE car_rental_history (
  VIN int(11) NOT NULL,
  MemberID int(11) NOT NULL,
  PickupOdometer int(11) NOT NULL,
  DropoffOdometer int(11) NOT NULL,
  Status varchar(11) NOT NULL CHECK (Status = 'normal' OR Status = 'damaged' OR Status = 'not running') ,
  Date date NOT NULL
  primary key (VIN, MemberID, PickupOdometer, DropoffOdometer, Status, Date));
```

VIN	MemberID	PickupOdometer	DropoffOdometer	Status	Date
20140294	20	30000	32500	normal	2014-01-30
20140295	24	28000	90000	damaged	0000-00-00
20140296	32	0	100000	not running	2016-01-19

Car_Maintenance_History

```
CREATE TABLE car_maintenance_history (
  VIN int(11) NOT NULL,
  Date date NOT NULL,
  Odometer int(11) NOT NULL,
  Maintenance varchar(40) NOT NULL CHECK (Maintenance = 'scheduled' OR Maintenance = 'repair' OR Maintenance = 'body work'),
  Description varchar(80) NOT NULL,
  primary key (VIN, Date, Odometer, Maintenance, Description));
```

VIN	Date	Odometer	Maintenance	Description
20140294	1998-07-04	84000	Scheduled	Scheduled mainenance for oil check.
20140295	2014-02-18	68000	Repair	Repair the front bumper.
20140296	2012-12-20	9000	Body Work	Putting on cool racing stripes.

Rental_Comment

```
CREATE TABLE rental_comment (
  VIN int(11) NOT NULL,
  MemberID int(11) NOT NULL,
  Rating int(11) NOT NULL CHECK (Rating > 0 AND Rating < 5),
  Comment varchar(500) NOT NULL,
  Date date NOT NULL,
  ReplyComment varchar(500) NOT NULL,
  ReplyDate date NOT NULL,
  primary key (VIN, MemberID, Rating, Comment, Date, ReplyComment, ReplyDate));
```

VIN	MemberID	Rating	Comment	Date	ReplyComment	ReplyDate
20140294	20	1	Terrible car goes way to fast	2015-01-02		0000-00-00
20140295	24	1	Terrible car goes way to slow	2014-05-28	You should change gears then...	2015-02-03
20140296	32	4	Great car goes way to fast	2016-05-03		0000-00-00

Reservations

```
CREATE TABLE reservations (
  ReservationID int(11) NOT NULL,
  MemberID int(11) NOT NULL,
  VIN int(11) NOT NULL,
  StartDate date NOT NULL,
  EndDate date NOT NULL,
  AccessCode int(11) NOT NULL
  primary key (ReservationID),
  foreign key (VIN) references Car (VIN),
  foreign key (MemberID) references KTCS_Member(MemberID));
```

ReservationID	MemberID	VIN	StartDate	EndDate	AccessCode
26	20	20140294	1998-07-04	2000-12-08	7897823
44	32	20140296	2012-12-20	2012-12-22	7897823
82	24	20140295	2014-02-18	2016-04-02	424342

KTCS_Member

```
CREATE TABLE ktcs_member (
  MemberID int(11) NOT NULL,
  NameFirst varchar(40) NOT NULL,
  NameLast varchar(40) NOT NULL,
  AddressLine varchar(40) NOT NULL,
  PostalCode varchar(20) NOT NULL,
  Province varchar(30) NOT NULL,
  City varchar(40) NOT NULL,
  Country varchar(40) NOT NULL,
  PhoneNumber varchar(10) NOT NULL,
  Email varchar(100) NOT NULL,
  DriverLicense varchar(100) NOT NULL,
  MembershipFee decimal(10,2) NOT NULL,
  Password varchar(20) NOT NULL,
  Credit_Card varchar(20) NOT NULL,
  primary key (MemberID));
```

Please note: the data dump for the 'KTCS_Member' table had too many attributes (14) to fit on one page. Therefore, we replicated the large 14-column output into two tables in order to fit them on the page. All values in the tables below are identical to the actual MySQL data dump for the 'KTCS_Member' table.

MemberID	NameFirst	NameLast	AddressLine	PostalCode	Province	City
20	Andrew	Hello	10 Hello Lane	K7L1V2	Ontario	Kingston
24	Ryan	Freddy	10 Goodbye Lane	K7L8F3	Ontario	Kingston
32	Rony	Bes	10 Database Lane	K7H8Z3	Ontario	Toronto

Country	PhoneNumber	Email	DriverLicense	MembershipFee	Password	Credit_Card
Canada	647111111	hello@hello.com	B2746-1026-336-3048	30.00	Ilikedogs	5301063177596486
Canada	6472345678	bye@bye.com	C9384-1026-232-3048	30.00	Ilikecats	5231094377093486
Canada	6478439900	dbms@dbms.com	F9020-3231-333-9809	30.00	ilikebirds	5237483277093486

Payment_History

```
CREATE TABLE payment_history (
  MemberID int(11) NOT NULL,
  Amount decimal(10,2) NOT NULL,
  Date date NOT NULL,
  Description varchar(100) NOT NULL,
  primary key (MemberID, Amount, Date, Description));
```

MemberID	Amount	Date	Description
20	344.10	2014-06-07	You rented the Tesla Model 3.
24	30.00	2012-01-31	Youre monthly payment fee.
32	1000.00	1996-04-07	You rented the Bugatti Veyron.

Admin

```
CREATE TABLE admin (
  AdminCode int(11) NOT NULL,
  Email varchar(100) NOT NULL,
  Password varchar(20) NOT NULL,
  primary key (AdminCode));
```

AdminCode	Email	Password
23121	hello@gmail.com	helloworld
42342	bye@gmail.com	byeworld
42421	hello@bye.com	hellobyeworld