Course title: Data base 420-921-VA

Project title: Car2Go

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Introduction:

This report is about the design of the management system database for a car rental company called Car2Go. The different possibilities of the presented scenario were examined to access the database presented in this report.

The first step in designing the Car2Go database was the conceptual design of the database which includes the complete Entity-Relationship (ER) model of our database, including tables listing entities involved in relationships along with relationship labels and connectivity.

The second step was to prepare the database schema, which represents the logical configuration of all parts of the ER diagram that we achieved from the conceptual design of the database. Then we listed the relationship schemas of the database along with a table listing foreign keys, referenced relationships, and referencing relationships.

The third step was to list the functional dependencies identified for each relationship that we got from the logical schema of the database. In the normalization process, all tables were in normal forms 1NF, 2NF and 3NF.

The fourth step was to create a database with tables according to the relational schema using DDL statements that support all constraints. All tables have been successfully implemented.

The last step was to use the DML statements, populate the tables with a reasonable amount of data, and print the contents of each table after populating the tables No error message received, and implementation was successful.

Since this was our first database design experience, we encountered some challenges and doubts during the implementation of this project. These challenges required a lot of teamwork consultations, which was a valuable experience for all team members. Overall, the design of the database was the most challenging step for all of us.

Team Work Distribution

To practice and being experienced in database designing, our team members made the decision that each team member would do each step of the project individually and then combine all the tasks together. It was a good decision we made, because all the team members get experience in all steps of Car2Go project as well as discussing and benefiting of all members way of thinking. This project was a mindset sharing for us and a pleasant experience of a teamwork project.

	Tasks	Done by
1	Description	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
2	Business rules or Assumptions	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
3	Conceptual Design - ERD	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
4	Logical Design - Relational Schema	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
5	Normalization	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
6	DDL	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
7	DML	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
8	Queries_script.sql	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan
9	Project Report	Alexander Gutkovsky, Zahra Mirzaei, Enes Karaaslan

Scenario description

A company named Car2Go runs a rental business in several locations with different addresses. Car2Go provides subcompacts, compacts, sedans, or luxury car options with different properties. The company rents the car with full tank and records the volume of gas in the tank when the car is returned as well as the odometer reading before renting and after returning the car. The rented car in a particular location may be returned to a different location without extra charges. A customer can rent only one car at any given time and if the company does not have the customer requested car in stock, may provide a higher car class with the price of the customer's requested car class. For certain weeks in the year, the company has promotional rentals for only a car class. Cra2Go keeps the record of customers. Calculation of prices are based on car classes, duration of renting days as well as promotion percentage if applicable.

1. The location table stores information about branches.
   - Location_id is unique (Primary Key) in location table to uniquely identify each row of the table

2. The location rent keeps record of the location in which car rented and returned
   - Rent_id as well as location_start are unique in location_rent relation

3. The car stores information about particular properties of the cars
   - plate is unique in car relation

4. The car options are classified and car class keeps record of car options
   - class_name is unique in car_class relation

5. The customer table keeps information about the customers
   - driving_license_no is unique in customer table

6. The customer phone keeps record of the customers' phone number
   - customer_ph is unique in customer_ph table

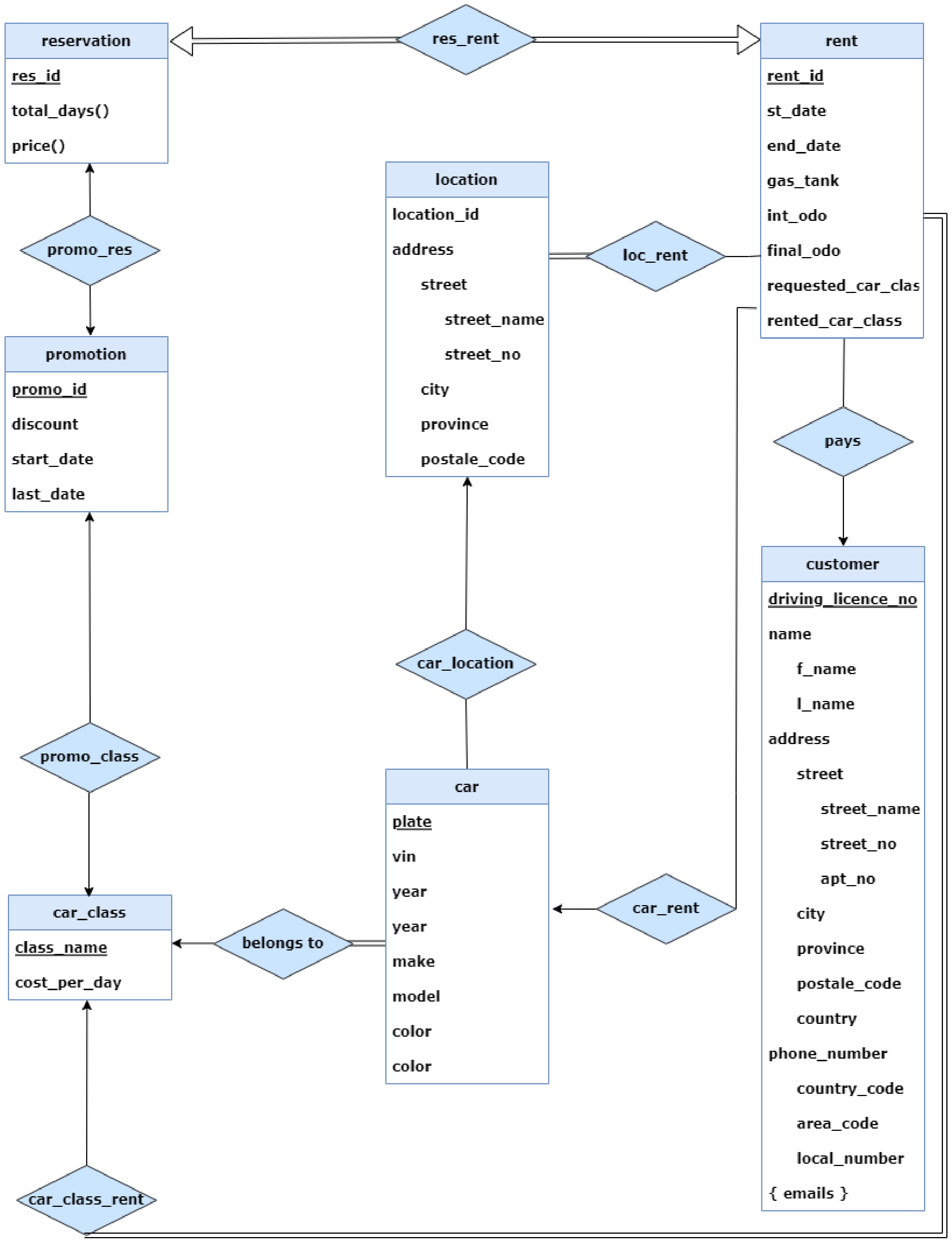
7. The customer email keeps record of the customers' email
   - customer_email is unique in customer_email relation

8. The rent keeps records of rented car by the customer
   - rent_id is unique in rent relation

9. The promotion keeps record of the given yearly promotions
   - promo_id is unique in promotion table

10. The reservation keeps record of total rented days as well as price
    - res_id is unique in reservation relation

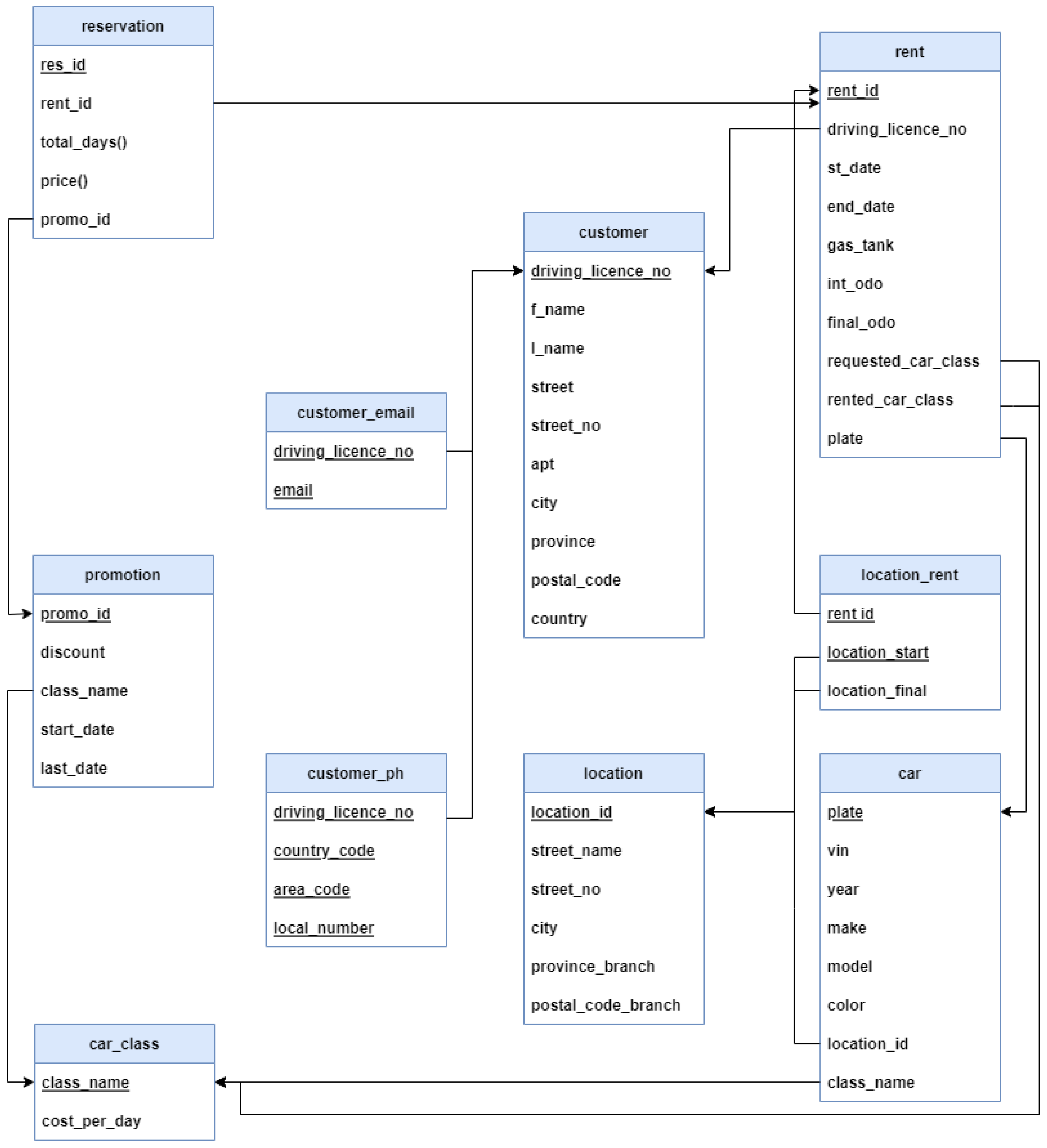
Conceptual Design of the Database



Logical Database Schema

- customer (driving_licence_no, f_name, l_name, street, street_no, apt, city, province, postal_code, country)
- customer_ph(driving_licence_no, country_code, area_code, local_number)
- customer_email(driving_licence_no, email)
- location(location_id, street_name, street_no, city, province_branch, postal_code_branch)
- car (plate, vin, year, make, model, color, class_name, location_id)
- rent(rent_id, driving_licence_no, st_date, end_date, gas_tank, int_odo, final_odo, requested_car_class, rented_car_class, plate)
- location_rent(rent_id, location_start, location_final)
- car_class(class_name, cost_per_day)
- promotion(promo_id, discount, class_name, start_date, last_date)
- reservation(res_id, total_days(), price(),rent_id, promo_id)

Yellow represents foreign key.


reservation
res_id
rent_id
total_days()
price()
promo_id
rent
rent_id
driving_licence_no
st_date
end_date
gas_tank
int_odo
final_odo
requested_car_class
rented_car_class
plate
customer
driving_licence_no
f_name
l_name
street
street_no
apt
city
province
postal_code
country
customer_email
driving_licence_no
email
promotion
promo_id
discount
class_name
start_date
last_date
location_rent
rent id
location_start
location_final
customer_ph
driving_licence_no
country_code
area_code
local_number
location
location_id
street_name
street_no
city
province_branch
postal_code_branch
car
plate
vin
year
make
model
color
location_id
class_name
car_class
class_name
cost_per_day

Functional Dependencies and Database Normalization

Customer relation:

driving_licence_no-> f_name, l_name, street, street_no, apt, city, province, postal_code, country

Location relation:

location_id--> street_name, street_no, city, province_branch, postal_code_branch

Car relation:

Plate-->vin, year, make, model, color, class_name, location_id

Rent relation:

rent_id--> driving_licence_no, st_date, end_date, gas_tank, int_odo, final_odo, requested_car_class, rented_car_class, plate

Location_rent relation:

rent_id, location_start--> location_final

Car_class relation:

class_name-->cost_per_day

Promotion relation:

promo_id-->discount, class_name, start_date, last_date

Reservation relation:

res_id-->total_days(), price (),rent_id, promo_id

(--> represents dependency, example: A-->B means, B depends on A)

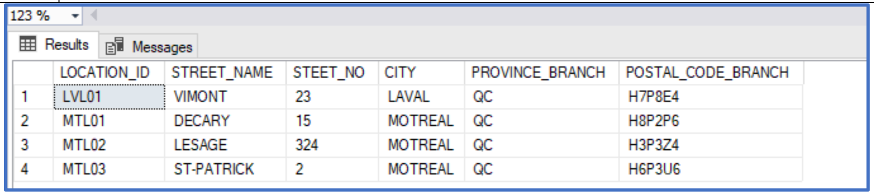
NORMALIZATION:

1. All the tables are in 1NF.
2. All the tables are in 2NF.
3. All the tables are in 3NF.

Database Tables

Table: Location

Attribute	Data type
LOCATION_ID	VARCHAR(5)
STREET_NAME	VARCHAR(30)
STEET_NO	INT
CITY	VARCHAR(30)
PROVINCE_BRANCH	VARCHAR(30)
POSTAL_CODE_BRANCH	VARCHAR(20)
Constraint	CONSTRAINT PK_LOCATION_ID primary key(LOCATION_ID)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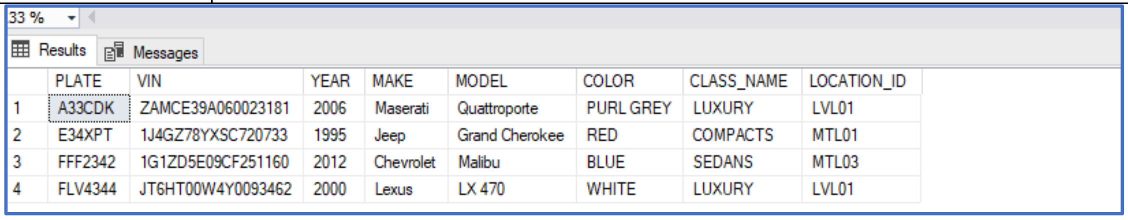
Results Messages

	LOCATION_ID	STREET_NAME	STEET_NO	CITY	PROVINCE_BRANCH	POSTAL_CODE_BRANCH
1	LVL01	VIMONT	23	LAVAL	QC	H7P8E4
2	MTL01	DECARY	15	MOTREAL	QC	H8P2P6
3	MTL02	LESAGE	324	MOTREAL	QC	H3P3Z4
4	MTL03	ST-PATRICK	2	MOTREAL	QC	H6P3U6

Table: Car

Attribute	Data type
PLATE	CHAR(9)
VIN	CHAR(17)
YEAR	INT
MAKE	VARCHAR(20)
MODEL	VARCHAR(20)
COLOR	VARCHAR(15)
CLASS_NAME	VARCHAR(30)
LOCATION_ID	VARCHAR(5)
Constraint	CONSTRAINT FK_CAR01 FOREIGN KEY(CLASS_NAME) REFERENCES CAR_CLASS (CLASS_NAME)
	CONSTRAINT FK_CAR02 FOREIGN KEY(LOCATION_ID) REFERENCES LOCATION (LOCATION_ID)
	CONSTRAINT PK_CAR PRIMARY KEY(PLATE)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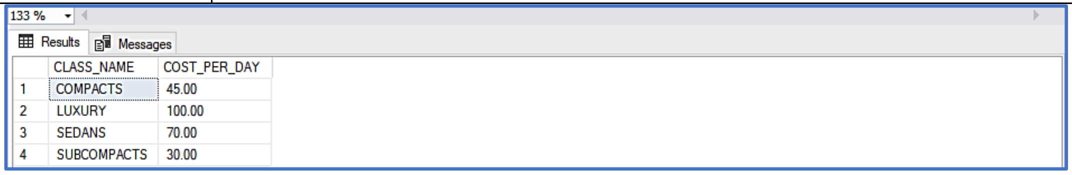
Results Messages

	PLATE	VIN	YEAR	MAKE	MODEL	COLOR	CLASS_NAME	LOCATION_ID
1	A33CDK	ZAMCE39A060023181	2006	Maserati	Quattroporte	PURL GREY	LUXURY	LVL01
2	E34XPT	1J4GZ78YXSC720733	1995	Jeep	Grand Cherokee	RED	COMPACTS	MTL01
3	FFF2342	1G1ZD5E09CF251160	2012	Chevrolet	Malibu	BLUE	SEDANS	MTL03
4	FLV4344	JT6HT00W4Y0093462	2000	Lexus	LX 470	WHITE	LUXURY	LVL01

Table: Car_Class

Attribute	Data type
CLASS_NAME	VARCHAR(30)
COST_PER_DAY	MONEY
Constraint	CONSTRAINT PK_CAR_CLASS PRIMARY KEY(CLASS_NAME)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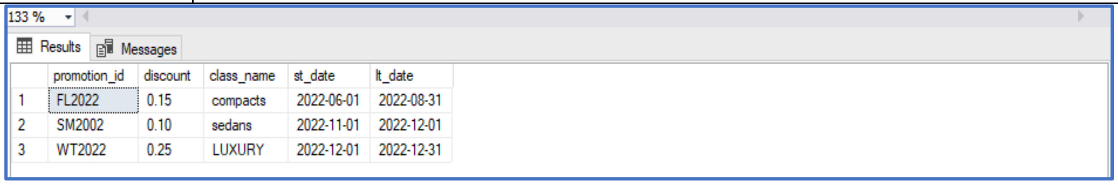
Results | Messages

	CLASS_NAME	COST_PER_DAY
1	COMPACTS	45.00
2	LUXURY	100.00
3	SEDANS	70.00
4	SUBCOMPACTS	30.00

Table: Promotion

Attribute	Data type
promotion_id	VARCHAR(20)
discount	DECIMAL(3,2)
class_name	VARCHAR(30)
st_date	date
lt_date	date
Constraint	constraint pk_promtion primary key(promotion_id)
	Constraint fk_promotion01 foreign key (class_name) references car_class(class_name)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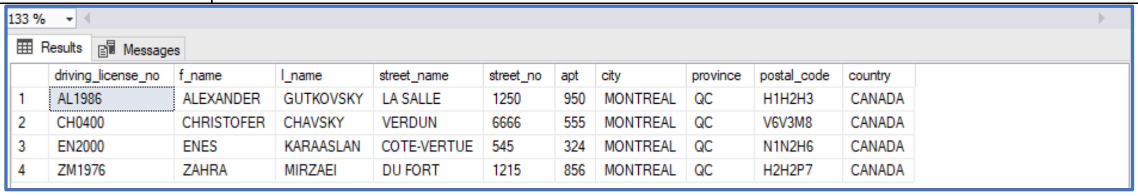
Results | Messages

	promotion_id	discount	class_name	st_date	lt_date
1	FL2022	0.15	compacts	2022-06-01	2022-08-31
2	SM2002	0.10	sedans	2022-11-01	2022-12-01
3	WT2022	0.25	LUXURY	2022-12-01	2022-12-31

Table: Customer

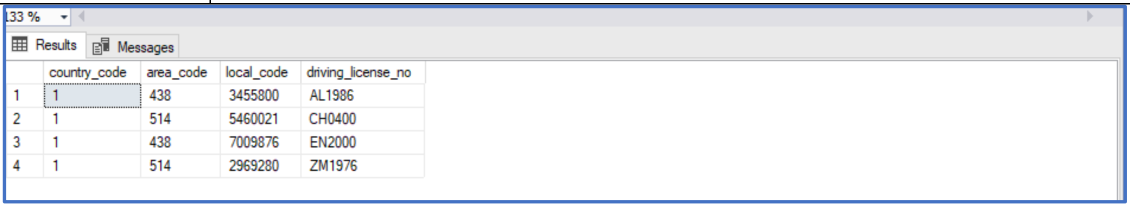
Attribute	Data type
`driving_license_no`	`VARCHAR(20)`
`f_name`	`VARCHAR(30)`
`l_name`	`VARCHAR(30)`
`street_name`	`VARCHAR(30)`
`street_no`	`int`
`apt`	`int`
`city`	`VARCHAR(30)`
`province`	`VARCHAR(30)`
`postal_code`	`VARCHAR(30)`
`country`	`VARCHAR (30)`
Constraint	`constraint  pk_driving_license_no primary key( driving_license_no)`



	driving_license_no	f_name	l_name	street_name	street_no	apt	city	province	postal_code	country
1	AL1986	ALEXANDER	GUTKOVSKY	LA SALLE	1250	950	MONTREAL	QC	H1H2H3	CANADA
2	CH0400	CHRISTOFER	CHAVSKY	VERDUN	6666	555	MONTREAL	QC	V6V3M8	CANADA
3	EN2000	ENES	KARAASLAN	COTE-VERTUE	545	324	MONTREAL	QC	N1N2H6	CANADA
4	ZM1976	ZAHRA	MIRZAEI	DU FORT	1215	856	MONTREAL	QC	H2H2P7	CANADA

Table: Customer_ph

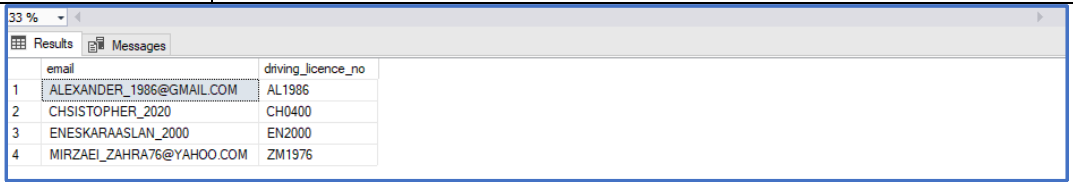
Attribute	Data type
`country_code`	`int`
`area_code`	`int`
`local_code`	`int`
`driving_license_no`	`VARCHAR (20)`
Constraint	`constraint  pk_customer_ph primary key(driving_license_no, country_code, area_code, local_code)`
	`constraint fk_customer_ph foreign key(driving_license_no) references customer(driving_license_no)`



	country_code	area_code	local_code	driving_license_no
1	1	438	3455800	AL1986
2	1	514	5460021	CH0400
3	1	438	7009876	EN2000
4	1	514	2969280	ZM1976

Table: Custome_email

Attribute	Data type
email	VARCHAR(30)
driving_licence_no	VARCHAR(20)
Constraint	Constraint pk_customer_email primary key(email,driving_licence_no)
	constraint fk_customer_email foreign key(driving_licence_no) references customer(driving_license_no)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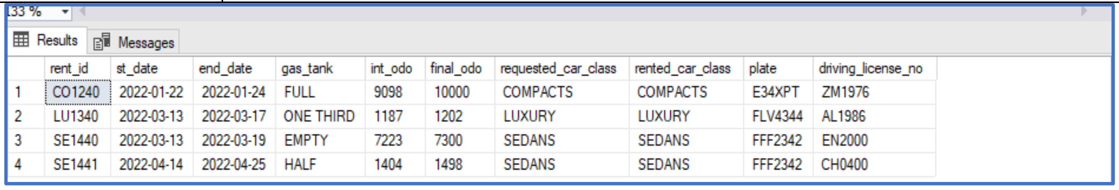
Results | Messages

	email	driving_licence_no
1	ALEXANDER_1986@GMAIL.COM	AL1986
2	CHSISTOPHER_2020	CH0400
3	ENESKARAASLAN_2000	EN2000
4	MIRZAEI_ZAHRA76@YAHOO.COM	ZM1976

Table: Rent

Attribute	Data type
rent_id	VARCHAR(20)
st_date	DATE
end_date	DATE
gas_tank	VARCHAR(15)
int_odo	int
final_odo	int
requested_car_class	VARCHAR(30)
rented_car_class	VARCHAR(30)
plate	CHAR(9)
driving_license_no	VARCHAR (20)
Constraint	constraint fk_rent02 foreign key(driving_license_no) REFERENCES customer (driving_license_no)
	constraint fk_rent01 foreign key(plate) REFERENCES car (plate)
	constraint fk_rent03 foreign key(requested_car_class) references car_class(class_name)
	constraint fk_rent04 foreign key(rented_car_class) references car_class(class_name)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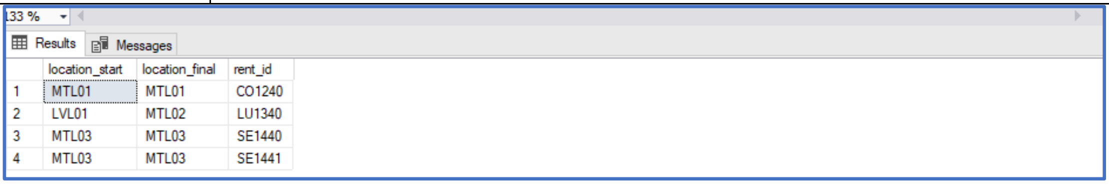
Results | Messages

	rent_id	st_date	end_date	gas_tank	int_odo	final_odo	requested_car_class	rented_car_class	plate	driving_license_no
1	CO1240	2022-01-22	2022-01-24	FULL	9098	10000	COMPACTS	COMPACTS	E34XPT	ZM1976
2	LU1340	2022-03-13	2022-03-17	ONE THIRD	1187	1202	LUXURY	LUXURY	FLV4344	AL1986
3	SE1440	2022-03-13	2022-03-19	EMPTY	7223	7300	SEDANS	SEDANS	FFF2342	EN2000
4	SE1441	2022-04-14	2022-04-25	HALF	1404	1498	SEDANS	SEDANS	FFF2342	CH0400

Table: Location_rent

Attribute	Data type
location_start	VARCHAR(5)
location_final	VARCHAR(5)
rent_id	VARCHAR (20)
Constraint	constraint pk_location_rent primary key(rent_id,location_start)
	constraint fk_location_rent foreign key(rent_id) references rent(rent_id)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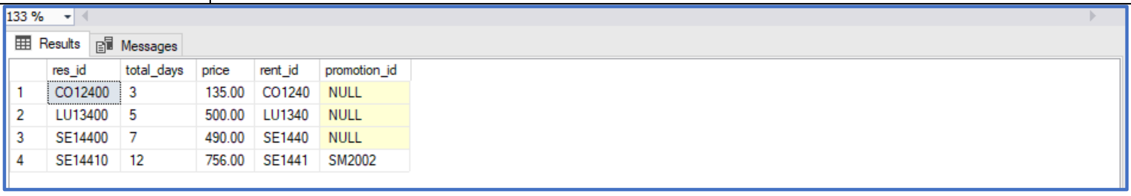
Results   Messages
    location_start  location_final  rent_id
1   MTL01           MTL01           CO1240
2   LVL01           MTL02           LU1340
3   MTL03           MTL03           SE1440
4   MTL03           MTL03           SE1441
```

Table: Reservation

Attribute	Data type
res_id	VARCHAR(20)
total_days	int
price	MONEY
rent_id	VARCHAR(20)
promotion_id	VARCHAR(20)
Constraint	constraint pk_reservation primary key(res_id)
	CONSTRAINT FK_reservation01 FOREIGN KEY (rent_id) REFERENCES rent (rent_id)
	CONSTRAINT FK_reservation02 FOREIGN KEY (promotion_id) REFERENCES promotion (promotion_id)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Results   Messages
    res_id    total_days  price   rent_id  promotion_id
1   CO12400   3           135.00  CO1240   NULL
2   LU13400   5           500.00  LU1340   NULL
3   SE14400   7           490.00  SE1440   NULL
4   SE14410   12          756.00  SE1441   SM2002
```

Challenges and Suggestions for improvements

During the analysis and implementation of this project, there were some challenges that were encountered. When analyzing the scenario, there was difficulty in understanding the usage of “rural-route address”. After having discussion with our lecturer, we found out that there were some places with no regular address. Challenges were also faced during the creation of the conceptual design. We applied some useful resources to help us understand what to do and how to do it.

The Car2Go database design was a new and unique experience for us with valuable results that will be beneficial and useful for our career in the future.

Conclusions and Future Work

In this project, we learned how to design a database system for car rental companies that focus on database creation, good ER schema building rules, how to create a relational schema with the ER diagram, derive function dependencies, how to normalize a relational schema and how different entities interact with each other. We also learned how to design a system from a database perspective and how to manage, store, maintain and manipulate data accurately.

Future Enhancements

In the near future, we will make some additions to the system as follows:

--Providing customer-member relations to give extra discount to the members
--Providing payment methods:

- Checks.
- Debit cards.
- Credit cards.
- Mobile payments.
- Electronic bank transfers

--Providing insurance coverage

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