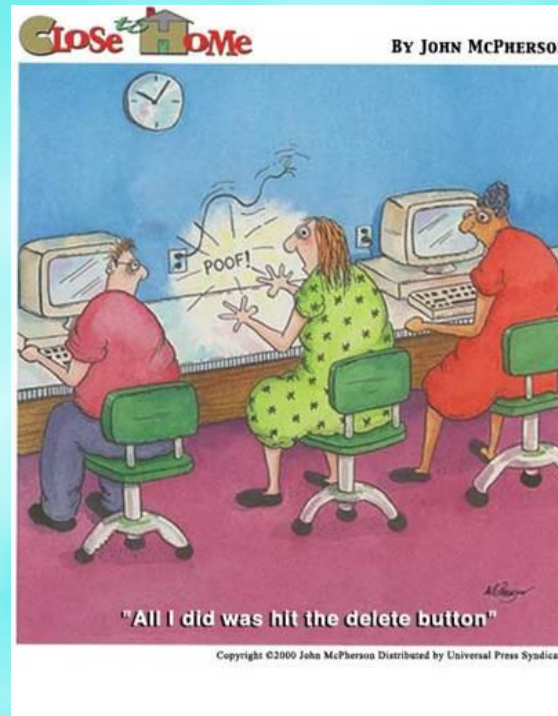
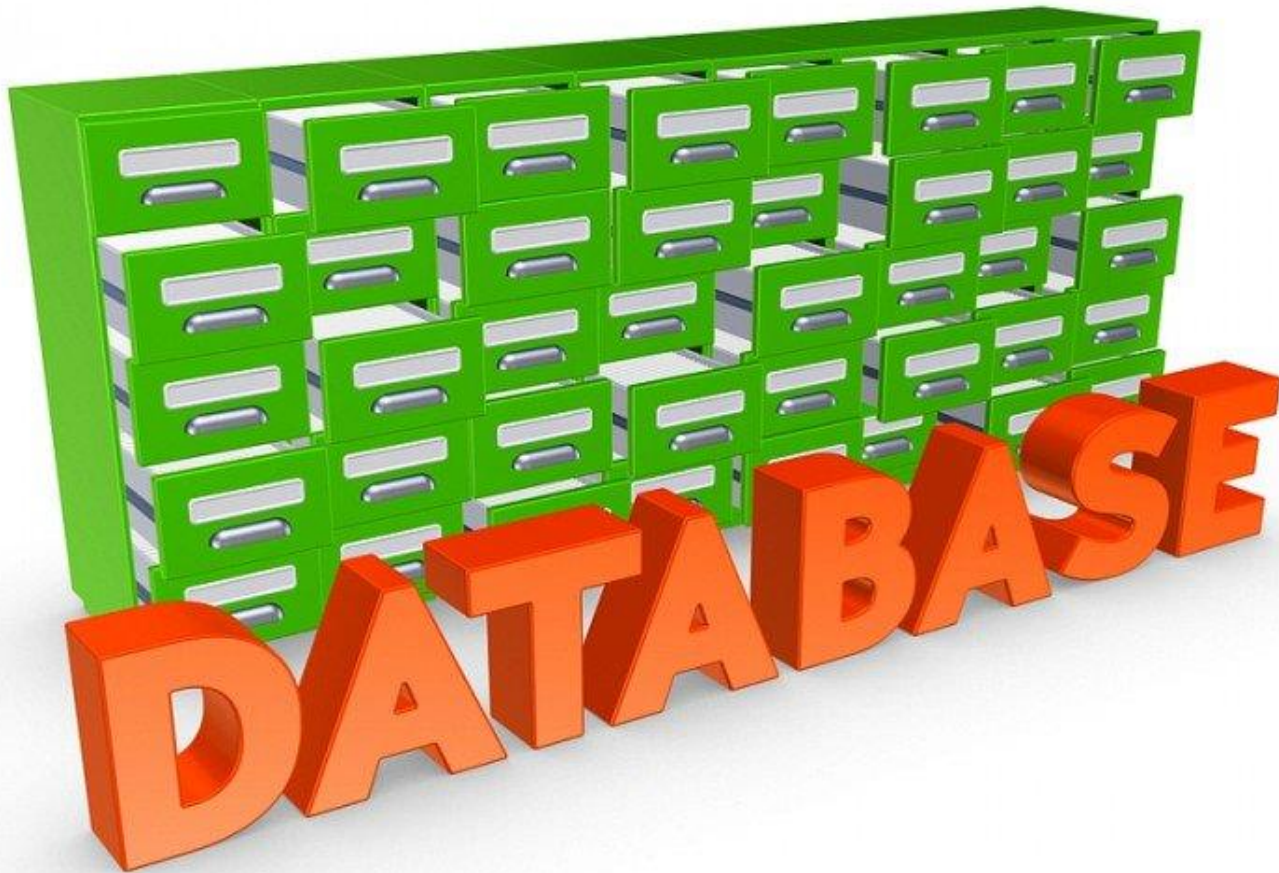


DATABASE



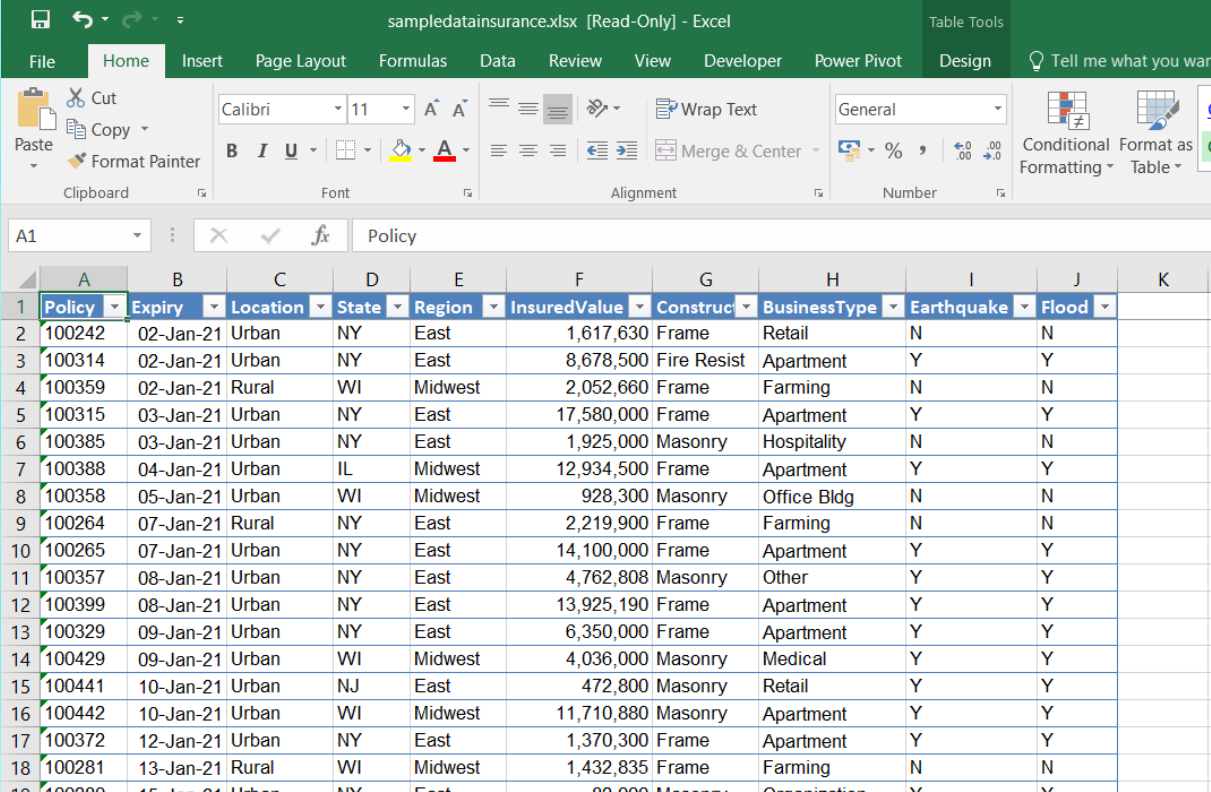
What is a Database (db)?



A database:

- is an organised collection of data, typically stored in electronic format.
- should make it easy for you to find and extract the exact data that you require.
- can work with database files much larger than available memory (RAM).
- has in-built data integrity
- has **Tables** as the primary form of data storage.

A **Table** is a named database data set that looks much like an Excel spreadsheet.

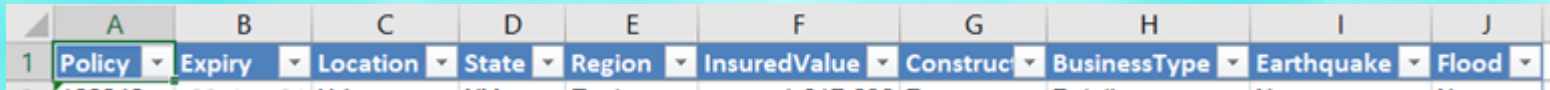


The screenshot shows an Excel spreadsheet with a table named 'Policy'. The table has 11 columns: Policy, Expiry, Location, State, Region, InsuredValue, Construc, BusinessType, Earthquake, Flood, and an empty column. The data is organized into rows, with the first row being the header and subsequent rows containing individual policy records. The table is displayed with a light blue header and alternating row colors for readability.

Policy	Expiry	Location	State	Region	InsuredValue	Construc	BusinessType	Earthquake	Flood	
100242	02-Jan-21	Urban	NY	East	1,617,630	Frame	Retail	N	N	
100314	02-Jan-21	Urban	NY	East	8,678,500	Fire Resist	Apartment	Y	Y	
100359	02-Jan-21	Rural	WI	Midwest	2,052,660	Frame	Farming	N	N	
100315	03-Jan-21	Urban	NY	East	17,580,000	Frame	Apartment	Y	Y	
100385	03-Jan-21	Urban	NY	East	1,925,000	Masonry	Hospitality	N	N	
100388	04-Jan-21	Urban	IL	Midwest	12,934,500	Frame	Apartment	Y	Y	
100358	05-Jan-21	Urban	WI	Midwest	928,300	Masonry	Office Bldg	N	N	
100264	07-Jan-21	Rural	NY	East	2,219,900	Frame	Farming	N	N	
100265	07-Jan-21	Urban	NY	East	14,100,000	Frame	Apartment	Y	Y	
100357	08-Jan-21	Urban	NY	East	4,762,808	Masonry	Other	Y	Y	
100399	08-Jan-21	Urban	NY	East	13,925,190	Frame	Apartment	Y	Y	
100329	09-Jan-21	Urban	NY	East	6,350,000	Frame	Apartment	Y	Y	
100429	09-Jan-21	Urban	WI	Midwest	4,036,000	Masonry	Medical	Y	Y	
100441	10-Jan-21	Urban	NJ	East	472,800	Masonry	Retail	Y	Y	
100442	10-Jan-21	Urban	WI	Midwest	11,710,880	Masonry	Apartment	Y	Y	
100372	12-Jan-21	Urban	NY	East	1,370,300	Frame	Apartment	Y	Y	
100281	13-Jan-21	Rural	WI	Midwest	1,432,835	Frame	Farming	N	N	
100280	15-Jan-21	Urban	NY	East	82,000	Masonry	Organization	Y	Y	

It is organised by rows and columns (also called a fields)

Columns form the table's structure.



	A	B	C	D	E	F	G	H	I	J
1	Policy	Expiry	Location	State	Region	InsuredValue	Construct	BusinessType	Earthquake	Flood

Each Column has a definition which defines items such as:

- Its name (usually descriptive of the data)
- Its size (length)
- The type of data it holds (numeric, Text, currency, Date....)
- Default value

Rows form the content of the table.

Each row contains associated data for each
Column

Each table must identify a column or group of columns, called the **Primary Key**, to uniquely identify each row.

Customer table

Column name

Primary Key

Type of data

Size

Rent-a-car.odb : Customer - LibreOffice Base: Table Design

File Edit View Tools Window Help

Icons: Save, Undo, Redo, Copy, Paste, Find, Print, etc.

	Field Name	Field Type	Description
	Cust_id	Integer [INTEGER]	
	lastname	Text [VARCHAR]	
	firstname	Text [VARCHAR]	
	address	Text [VARCHAR]	
	postal_code	Text [VARCHAR]	

<

Field Properties

AutoValue

Length

Default value

Format example 

A Database Management System (DBMS) is a software application:

- Used by end users to access the data stored in the database files.
- Used by a Database Administrator (DBA) to perform administrative tasks on the database and objects contained within the database.

DBMS is responsible for handling data requests, committing changes to the data and enforcing the structure of the database including:

- Ensuring data is stored properly and that rules for defining data are not violated.
- Providing a level of disaster recovery by which data can be restored to a consistent state.

- Maintaining relationships between data entities residing in the database.
- Allows Multi-user access

There are Four Types of Database Management System:

- Hierarchical database
- Network database
- Relational database
- Object-Oriented database

Relational DBMS is the most popular DBMS type used.

Relational Database
Management Software
(RDBMS)

RDBMS is a software system designed to allow the definition, creation, querying and updating of data stored in a relational database.

A few examples of RDBMS include:

- Microsoft SQL Server
- Microsoft Access
- MYSQL
- Oracle
- Libre BASE

Most home users are likely to use either Microsoft Access or Libre Base.

Both of these RDBMS's consist of:

Tables

Queries

Forms

Reports

RELATIONAL DATABASE

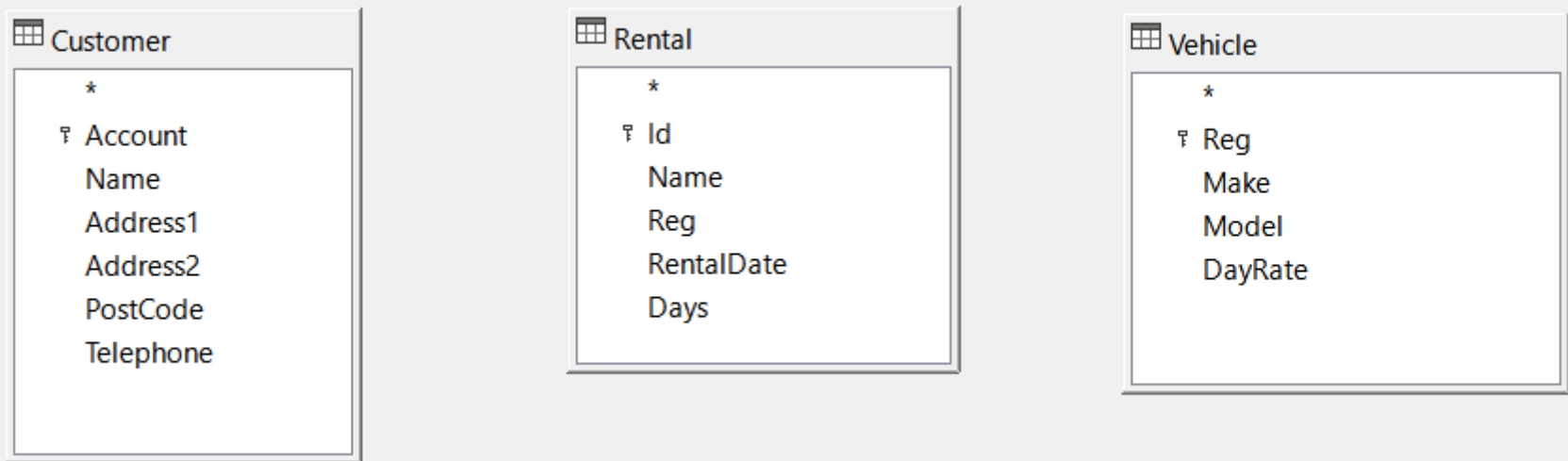
MS ACCESS & LIBRE BASE

Here we have database Tables for a Car Rental System.

CUSTOMER – Details of each customer

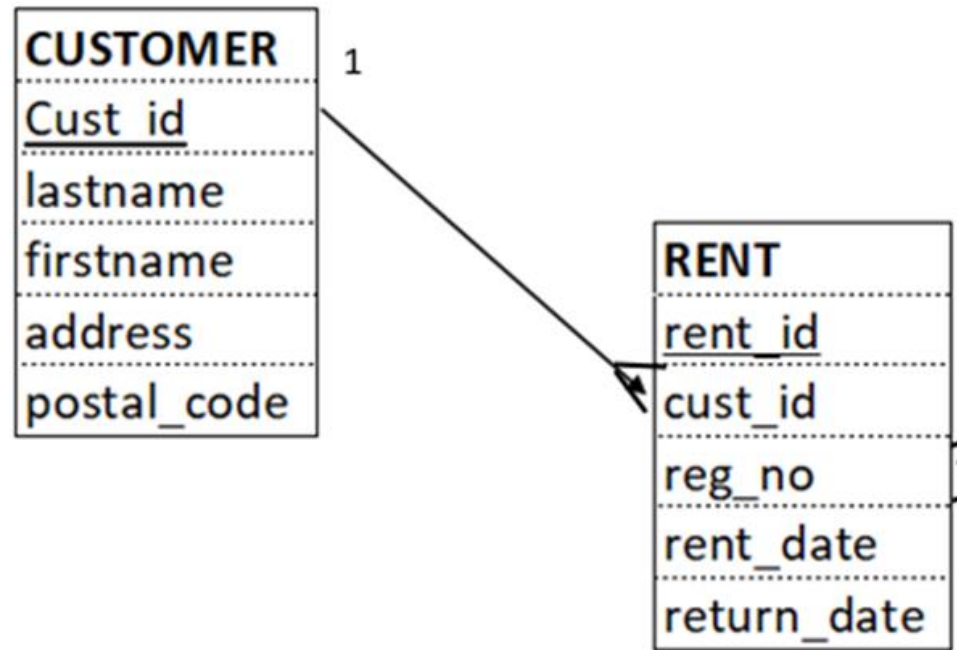
VEHICLE – Details of each car available to hire

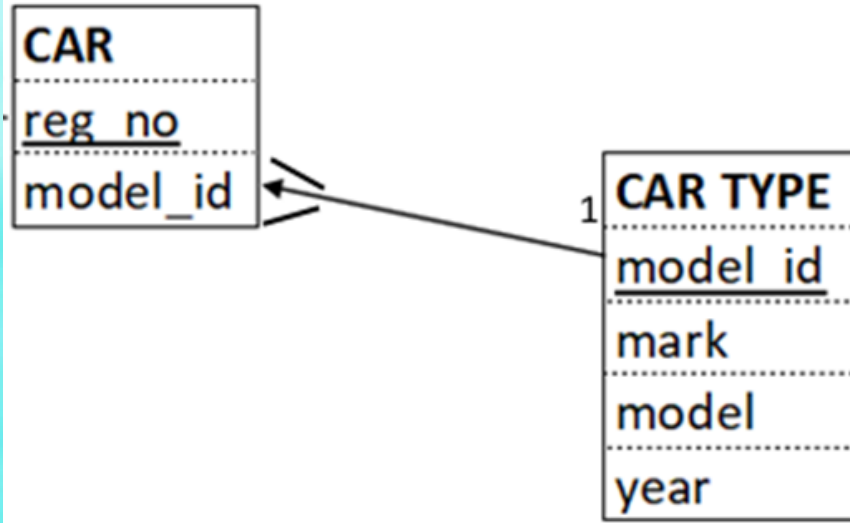
RENTAL – Details of cars rented by customers



HOW ARE THESE TABLES RELATED?

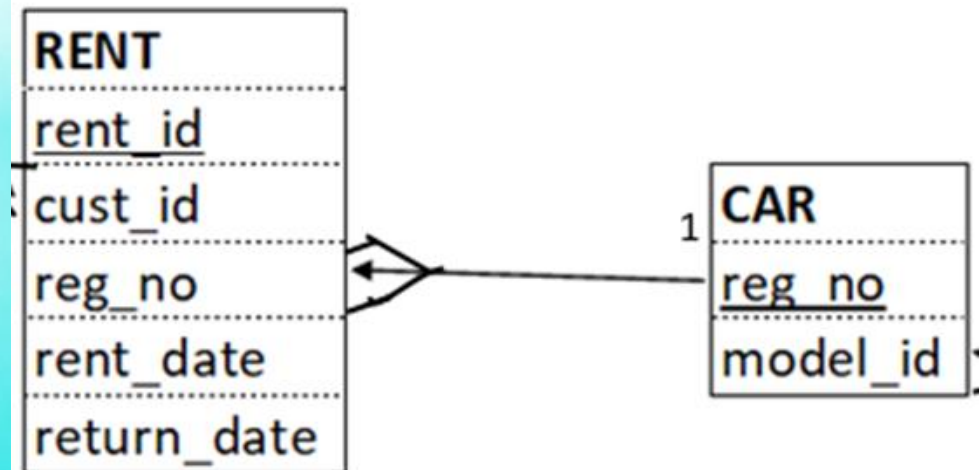
A customer can
have many
rental
agreements





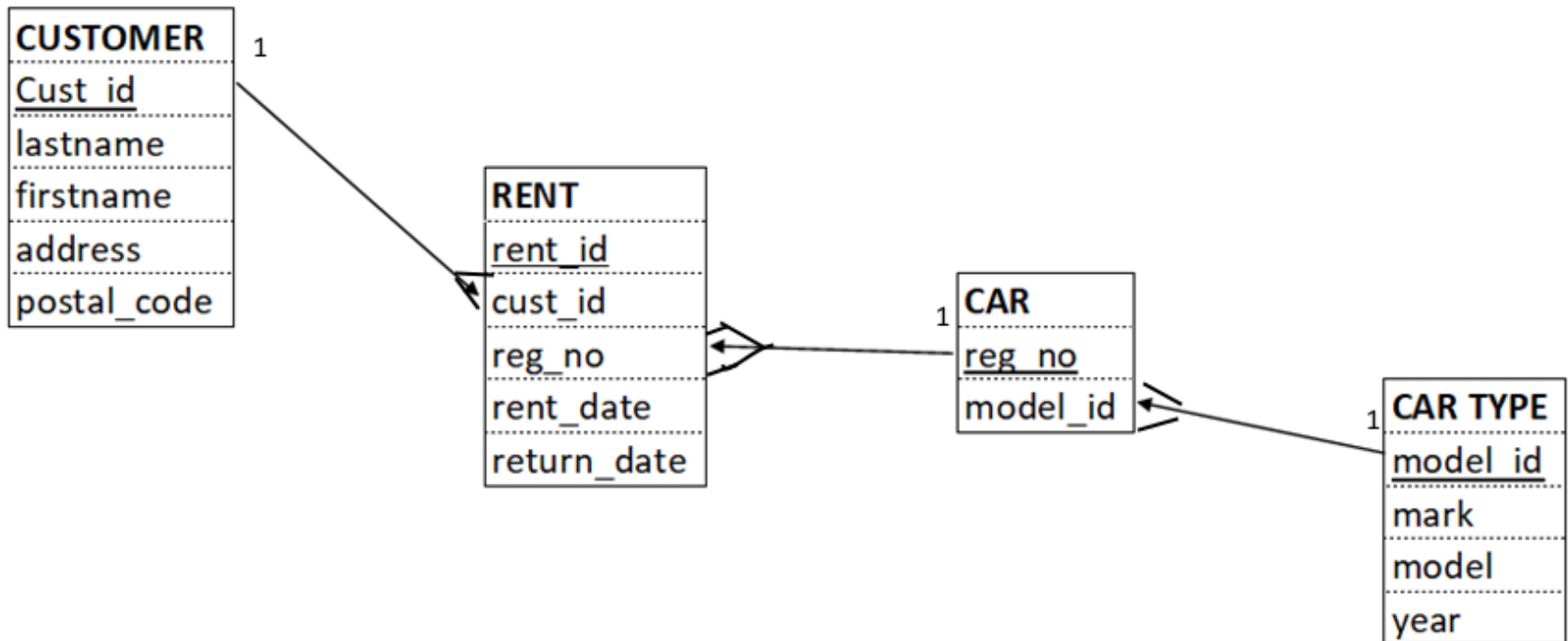
Many cars can exist for a particular model

Each car can be rented multiple times



A **relational database** is a collection of tables which are organised according to a relational model which shows the one to many relationships.

Rent-a-Car database



Primary Keys and Foreign Keys

Customer

	Cust_id	lastname	firstname	address	postal_code
▶ 1		Cramer	John	213 Main Street	UB6 78LE
	2	Adams	Steven	333 Bering Street	HA4 1AL
	3	Cramer	Ann	14 Wadhurst Road	HA5 7YT
	4	Martin	Andrew	744 Baker Street	UB5 3GA
	5	Smith	Patricia	55 Jeffer Way	UB3 1KL
	6	Pipps	Robert	62 Polk Street	UB3 2AA
	7	Hardy	Helen	77 Line Street	HA8 7CV
+					

A Primary Key
is the unique key
of the table

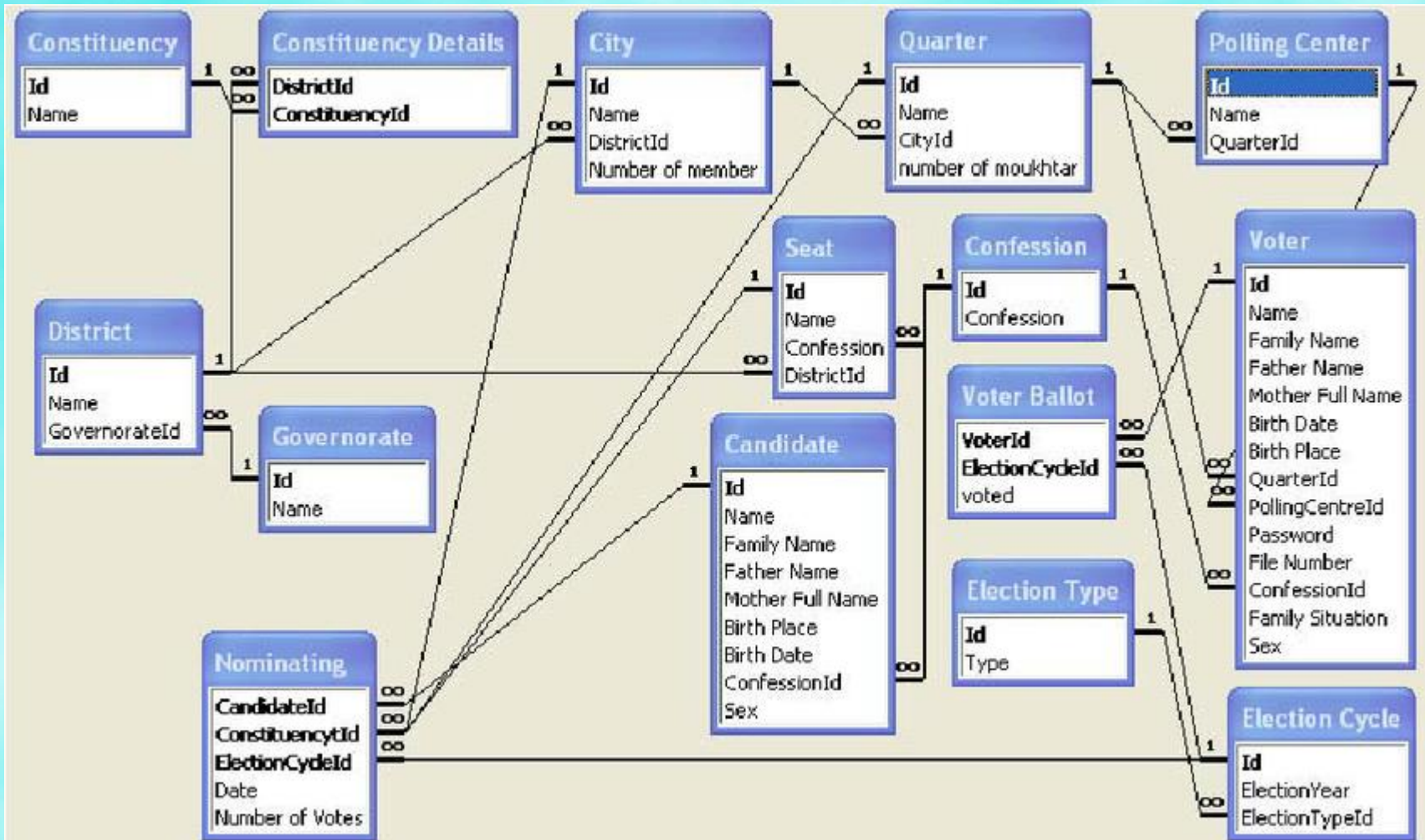
Rent



	rent_id	cust_id	reg_no	rent_date	return_date
▶ 1		1	HU66 GOP	29/12/18	04/01/19
	3	2	DR17 QZE	02/01/19	05/01/19
	4	3	HA17 VEH	06/01/19	08/01/19
	5	4	BP67 FLF	11/01/19	17/01/19
	6	5	JU18 SHQ	15/01/19	17/01/19
	7	6	HU66 GOP	19/01/19	20/01/19
	8	1	HA17 VEH	22/01/19	26/01/19
	9	7	BP67 FLF	26/01/19	
	10	8	ZE66 AIP	26/01/19	28/01/19
+					

A Foreign Key
Is a field that links
to the Primary Key
of another table

Local Elections Relational Model



Structure Query Language

Structure Query Language (SQL)

- Used to insert, retrieve, modify and delete data in a relational database.
- The language is supported by most relational databases with slight variations.
- Originally developed by IBM in mid 1970s.

Data Definition Language (DDL)

- Used by Database Analyst (DBA) for creating and modifying database objects.
- Create/Drop/Alter tables

Data Manipulation Language (DML)

- Used by end users
- To Query data in one or more tables
- To Insert/Delete/Update data rows in tables

- Basic form of SQL query:

```
SELECT <attributes>  
FROM   <one or more relations>  
WHERE  <conditions>
```

- SQL is not case sensitive

Customer table

	Cust_id	lastname	firstname	address	postal_code
▶	1	Cramer	John	213 Main Street	UB6 78LE
	2	Adams	Steven	333 Bering Street	HA4 1AL
	3	Cramer	Ann	14 Wadhurst Road	HA5 7YT
	4	Martin	Andrew	744 Baker Street	UB5 3GA
	5	Smith	Patricia	55 Jeffer Way	UB3 1KL
	6	Pipps	Robert	62 Polk Street	UB3 2AA
	7	Hardy	Helen	77 Line Street	HA8 7CV
+					

```
SELECT *  
FROM Customer  
WHERE lastname = 'Cramer' ;|
```

(* = All
Fields/Columns)

	Cust_id	lastname	firstname	address	postal_code
▶	1	Cramer	John	213 Main Street	UB6 78LE
	3	Cramer	Ann	14 Wadhurst Road	HA5 7YT
+					

Customer table

	Cust_id	lastname	firstname	address	postal_code
▶	1	Cramer	John	213 Main Street	UB6 78LE
	2	Adams	Steven	333 Bering Street	HA4 1AL
	3	Cramer	Ann	14 Wadhurst Road	HA5 7YT
	4	Martin	Andrew	744 Baker Street	UB5 3GA
	5	Smith	Patricia	55 Jeffer Way	UB3 1KL
	6	Pipps	Robert	62 Polk Street	UB3 2AA
	7	Hardy	Helen	77 Line Street	HA8 7CV
+					

```
SELECT firstname, lastname  
FROM Customer  
WHERE Cust_id > 4;
```

	firstname	lastname	
▶	Patricia	Smith	
	Robert	Pipps	
	Helen	Hardy	

Ordering the Results

	Cust_id	lastname	firstname	address	postal_code
▶	1	Cramer	John	213 Main Street	UB6 78LE
	2	Adams	Steven	333 Bering Street	HA4 1AL
	3	Cramer	Ann	14 Wadhurst Road	HA5 7YT
	4	Martin	Andrew	744 Baker Street	UB5 3GA
	5	Smith	Patricia	55 Jeffer Way	UB3 1KL
	6	Pipps	Robert	62 Polk Street	UB3 2AA
	7	Hardy	Helen	77 Line Street	HA8 7CV
+					

```
SELECT firstname, lastname  
FROM Customer  
WHERE Cust_id > 4  
ORDER BY lastname;
```

	firstname	lastname
▶	Helen	Hardy
	Robert	Pipps
	Patricia	Smith

CUSTOMER

	Cust_id	lastname	firstname	address	postal_code
▶	1	Cramer	John	213 Main Street	UB6 78LE
	2	Adams	Steven	333 Bering Street	HA4 1AL
	3	Cramer	Ann	14 Wadhurst Road	HA5 7YT
	4	Martin	Andrew	744 Baker Street	UB5 3GA
	5	Smith	Patricia	55 Jeffer Way	UB3 1KL
	6	Pipps	Robert	62 Polk Street	UB3 2AA
	7	Hardy	Helen	77 Line Street	HA8 7CV
+					

RENT

	rent_id	cust_id	reg_no	rent_date	return_date
▶	1	1	HU66 GOP	29/12/18	04/01/19
	3	2	DR17 QZE	02/01/19	05/01/19
	4	3	HA17 VEH	06/01/19	08/01/19
	5	4	BP67 FLF	11/01/19	17/01/19
	6	5	JU18 SHQ	15/01/19	17/01/19
	7	6	HU66 GOP	19/01/19	20/01/19
	8	1	HA17 VEH	22/01/19	26/01/19
	9	7	BP67 FLF	26/01/19	
	10	8	ZE66 AIP	26/01/19	28/01/19
+					

CAR TYPE

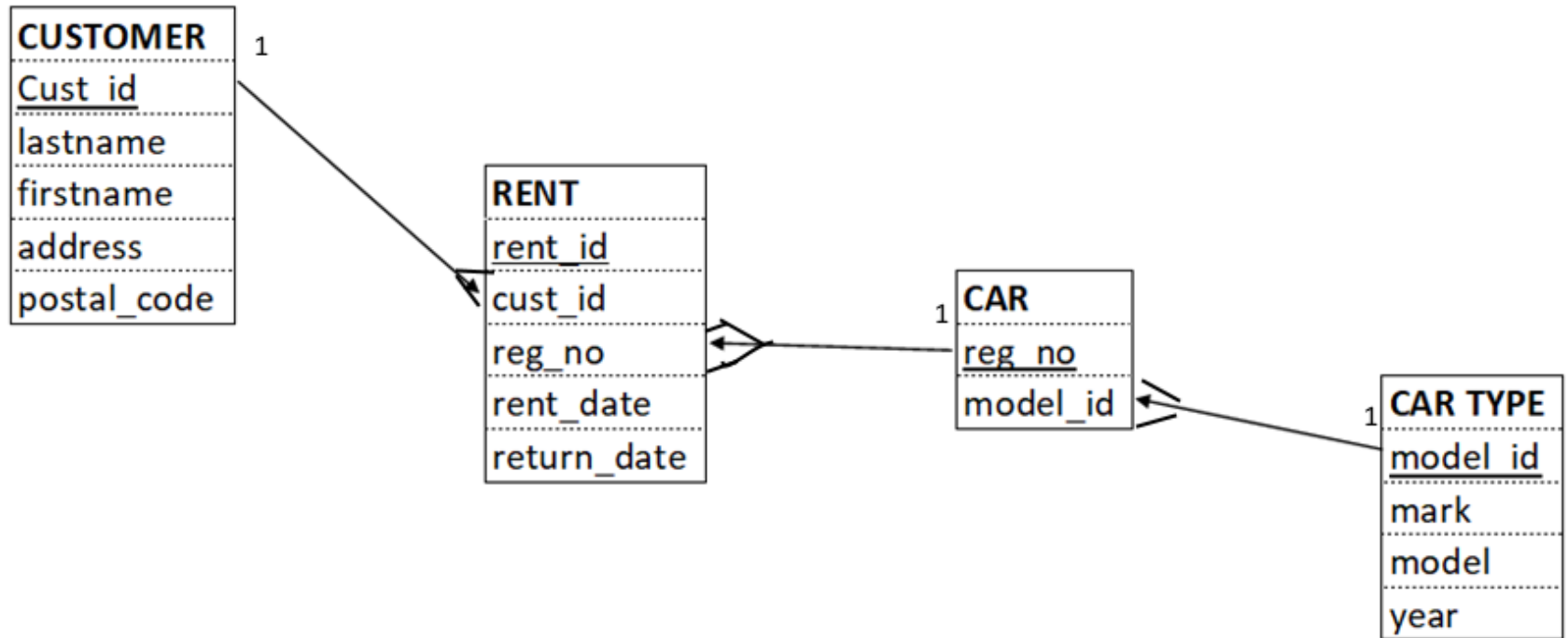
	model_id	make	model	year
▶	1	Ford	Focus	2017
	2	Ford	Mondeo	2018
	3	Peugeot	208	2017
	4	Peugeot	308	2018
	5	Renault	Clio	2017
	6	Renault	Megane	2016
+				

CAR

	reg_no	model_id
	YX17 JBT	1
	BP67 FLF	1
	AY17 KLM	1
	HU66 GOP	6
	ZE66 AIP	6
	EE18 PPL	2
	HA17 VEH	5
	TT67 RAP	5
	DR17 QZE	3
	JU18 SHQ	4
▶+		

Joins

Query to select data from multiple related tables.



We want to find all cars hired by John Cramer

Joins

Find all cars hired by John Cramer

```
SELECT "Customer"."firstname", "Customer"."lastname", "Rent"."reg_no",  
       "CarType"."make", "CarType"."model"  
FROM "Rent", "Customer", "Car", "CarType"  
WHERE "Rent"."cust_id" = "Customer"."Cust_id" AND "Car"."reg_no" = "Rent"."reg_no"  
AND "CarType"."model_id" = "Car"."model_id"  
AND "Customer"."firstname" = 'John' AND "Customer"."lastname" = 'Cramer'
```

	firstname	lastname	reg_no	make	model	
►	John	Cramer	HU66 GOP	Renault	Megane	
	John	Cramer	HA17 VEH	Renault	Clio	