
PLURALSIGHT

M&T Bank

Data Academy

Week 5

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PLURALSIGHT

What is a Database

A database is a structured collection of data that is organized and stored in a computer system. It is designed to efficiently manage, store, and retrieve large amounts of data for various applications and users.

- **Data organization**: Databases use a structured format to organize data into tables, rows, and columns, allowing for efficient storage and retrieval.
- **Data integrity**: Databases enforce data integrity by implementing rules and constraints that ensure the accuracy and consistency of the stored data.
- **Data security**: Databases provide mechanisms for controlling access to the data, ensuring that only authorized users can view, modify, or delete the stored information.
- **Data concurrency**: Databases support multiple users accessing and modifying the data simultaneously, while maintaining data consistency and integrity.
- **Data recovery**: Databases implement backup and recovery mechanisms to protect against data loss and ensure the availability of the stored information.

What is a Data Warehouse

A data warehouse (DW) is a type of database that is specifically designed for analytical rather than transactional work. It collects and aggregates data from various sources, such as operational databases, external data feeds, and more, to provide a consolidated and integrated view of the organization's data.

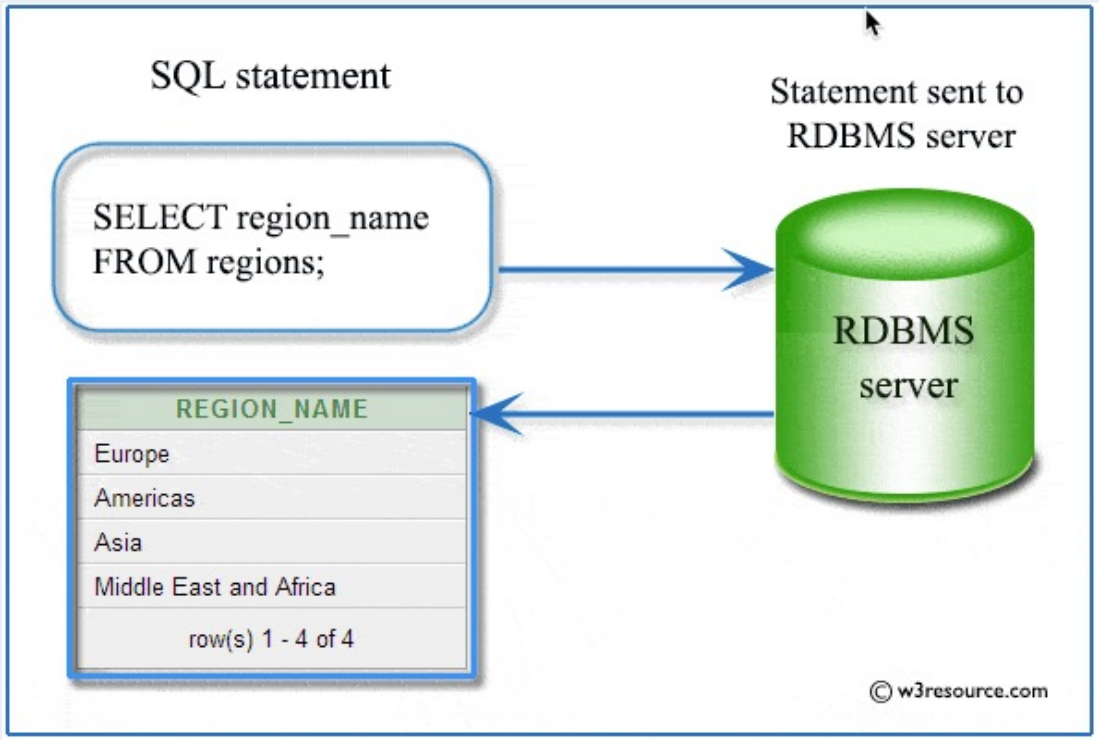
- **Structured and filtered data**: Data warehouses store structured, filtered, and pre-processed data that is optimized for analytical queries and reporting.
- **Historical data**: Data warehouses often include historical data, allowing users to analyze trends and patterns over time.
- **Separation of operational and analytical workloads**: Data warehouses are separate from operational databases, ensuring that analytical queries do not impact the performance of transactional systems.
- **Support for complex queries and reporting**: Data warehouses are optimized for complex analytical queries and reporting, allowing users to gain insights from large volumes of data.

What is SQL

SQL (often pronounced "sequel") stands for Structured Query Language.

It is a powerful tool that enables programmers to create, populate, manipulate, and access databases. It also provides an easy method for dealing with server-side storage.

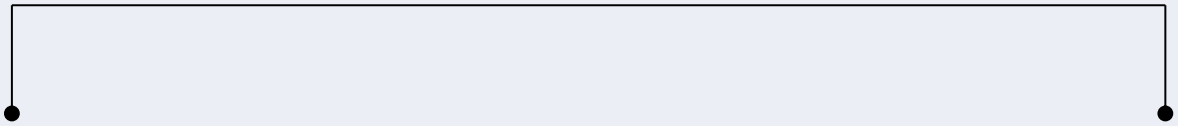
What is SQL



What is SQL

Data using SQL is stored in tables on the server, much like spreadsheets you would create in Microsoft Excel.

This makes the data easy to visualize and search.



Customer_ID	Date_ID
d005458dtsf	6/26/2019
d007sfgs847	8/3/2018
d004fgsfh445	12/3/2018

Order_ID	Customer_ID	Date_ID
10001	d005458dtsf	6/26/2019
10002	d007sfgs847	8/3/2018
10003	d004fgsfh445	12/3/2018

Using CRUD

Create Read Update Delete is a set of operations used with persistent storage.

Create	Create data in a table with the `INSERT` statement.
Read	Read data by using `SELECT`.
Update	Updated a table's data by using `UPDATE`.
Delete	Deleted data via `DELETE`.

ANATOMY OF SQL QUERY (READ)

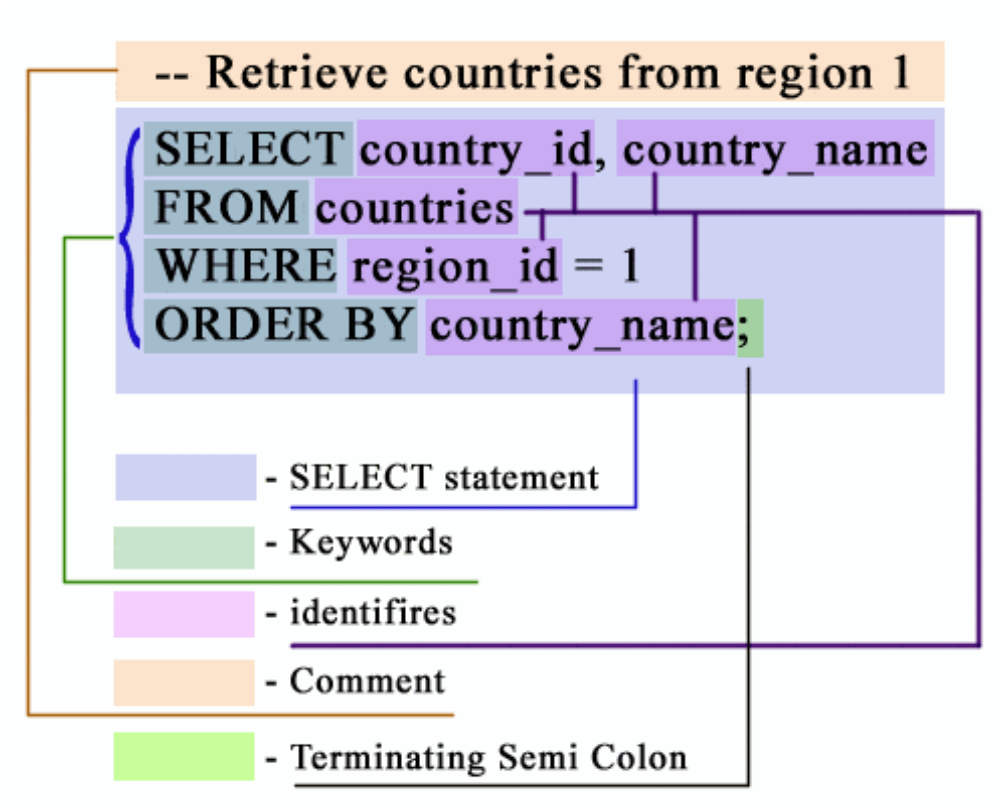
SELECT Used to specify the **columns** or expression you want to retrieve from the database

FROM Used to specify the **table** from which you want to retrieve the data

WHERE An optional clause used to filter the rows (data) returned

ORDER BY An optional clause used to sort the rows retuned by the query based on one or more columns.

SQL Query Elements



Query Example

The `SELECT` clause can specify more than one column.

```
SELECT pet_type, pet_name
FROM people
WHERE pet_type = 'dog'
AND pet_age < 5;
```

Query Example

Data is filtered by using additional clauses such as `WHERE` and `AND`.

```
SELECT pet_type, pet_name
FROM people
WHERE pet_type = 'dog'
 AND pet_age < 5;
```

Query Example

The `WHERE` clause will extract only the data that meets the condition specified. `AND` adds a second condition to the original clause, further refining the query.

```
SELECT pet_type, pet_name
  FROM people
  WHERE pet_type = 'dog'
  AND pet_age < 5;
```

Query Example

Note that unlike in Python where comparisons are done with a double equals (`==`) sign, in SQL only a single equal sign is used.

```
SELECT pet_type, pet_name
  FROM people
  WHERE pet_type = 'dog'
  AND pet_age < 5;
```

Wildcard: % and _

Use wildcards to substitute zero, one, or multiple characters in a string.
The keyword `LIKE` indicates the use of a wildcard.

```
SELECT *
FROM actor
WHERE last_name LIKE 'Will%';
```

Wildcard: % and _

The % will substitute zero, one, or multiple characters in a query.
In this example, all of the following are matches: Will, Willa, and Willows.

```
SELECT *
FROM actor
WHERE last_name LIKE 'Will%';
```

Wildcard: % and _

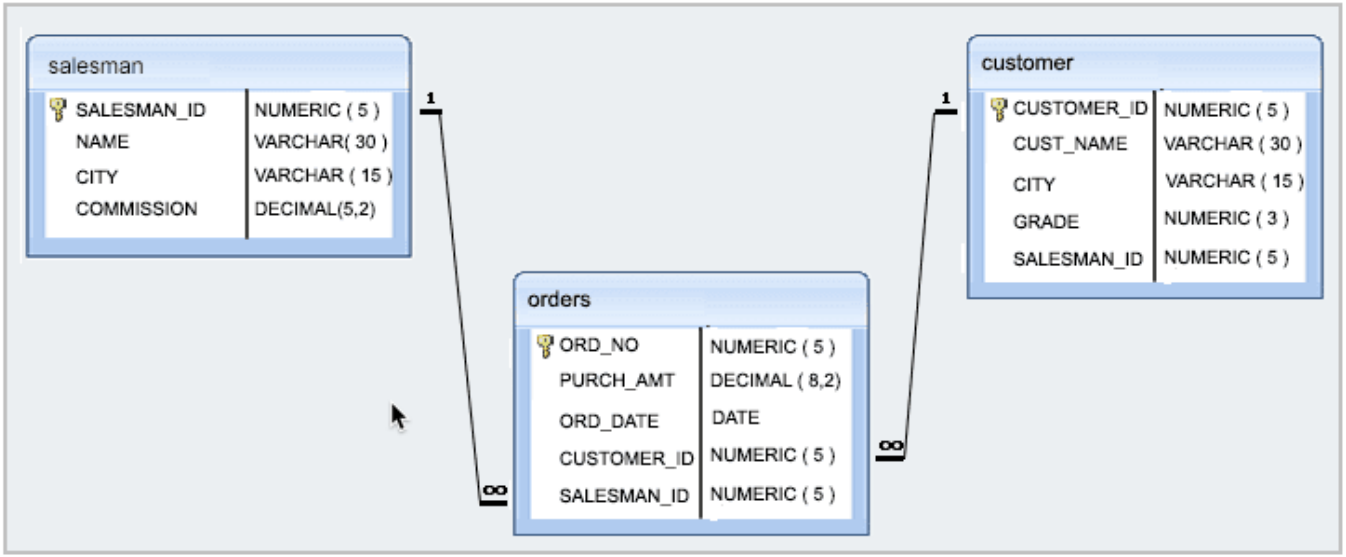
The `_` will substitute only **one** character in a query.

`_an` returns all actors whose first name contains three letters,
the second and third of which are `an`.

```
SELECT *
FROM actor
WHERE first_name LIKE '_an';
```

SELECT *

Structure of inventory database :



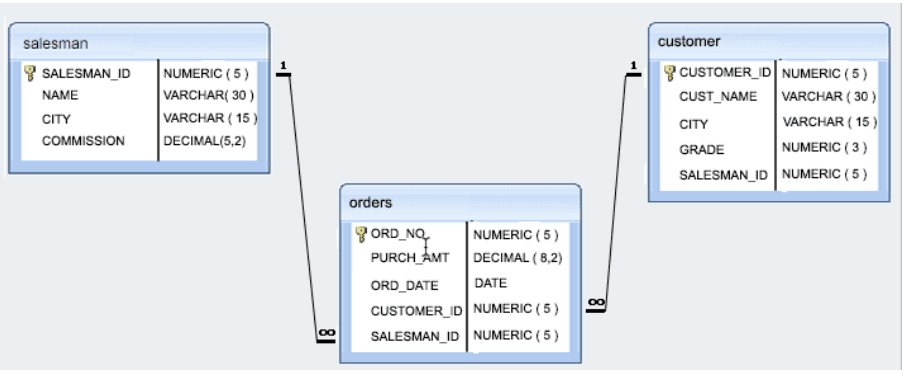
SELECT *

salesman_id	name	city	commission
5001	James Hoog	New York	0.15
5002	Nail Knite	Paris	0.13
5005	Pit Alex	London	0.11
5006	Mc Lyon	Paris	0.14
5003	Lauson Hense		0.12
5007	Paul Adam	Rome	0.13

```
SELECT * FROM salesman;
```

salesman_id	name	city	commission
5001	James Hoog	New York	0.15
5002	Nail Knite	Paris	0.13
5005	Pit Alex	London	0.11
5006	Mc Lyon	Paris	0.14
5003	Lauson Hense		0.12
5007	Paul Adam	Rome	0.13

SELECT COLUMNS IN DIFFERENT ORDER

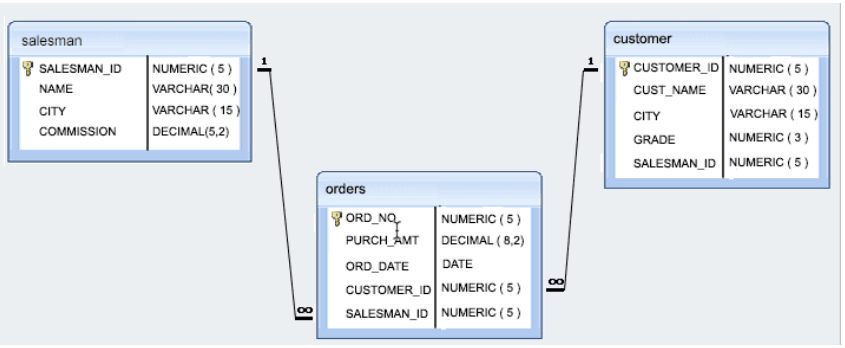


ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.50	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.50	2012-08-17	3009	5003
70007	948.50	2012-09-10	3005	5002
70005	2400.60	2012-07-27	3007	5001
70008	5760.00	2012-09-10	3002	5001
70010	1983.43	2012-10-10	3004	5006
70003	2480.40	2012-10-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.60	2012-04-25	3002	5001

```
SELECT ord_date,salesman_id,ord_no,purch_amt
FROM  orders;
```

ord_date	salesman_id	ord_no	purch_amt
2012-10-05	5002	70001	150.50
2012-09-10	5005	70009	270.65
2012-10-05	5001	70002	65.26
2012-08-17	5003	70004	110.50
2012-09-10	5002	70007	948.50
2012-07-27	5001	70005	2400.60
2012-09-10	5001	70008	5760.00
2012-10-10	5006	70010	1983.43
2012-10-10	5003	70003	2480.40
2012-06-27	5002	70012	250.45

UNIQUE VALUES



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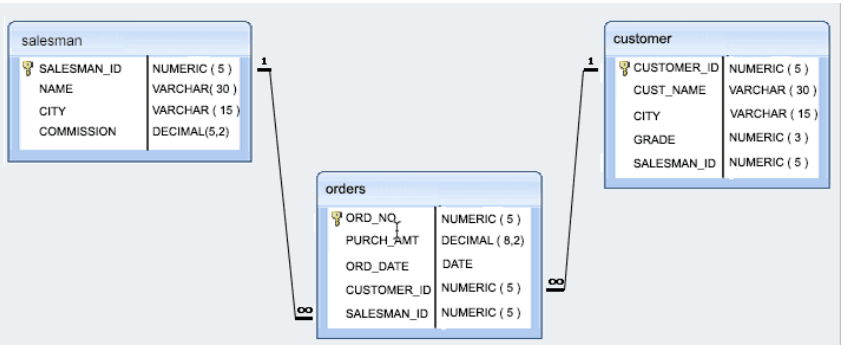
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.50	2012-08-17	3009	5003
70007	948.50	2012-09-10	3005	5002
70005	2400.60	2012-07-27	3007	5001
70008	5760.00	2012-09-10	3002	5001
70010	1983.43	2012-10-10	3004	5006
70003	2480.40	2012-10-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.60	2012-04-25	3002	5001

```
SELECT DISTINCT salesman_id
FROM  orders;
```

salesman_id
5006
5002
5001
5005
5003
5007

SPECIFY A CONDITION

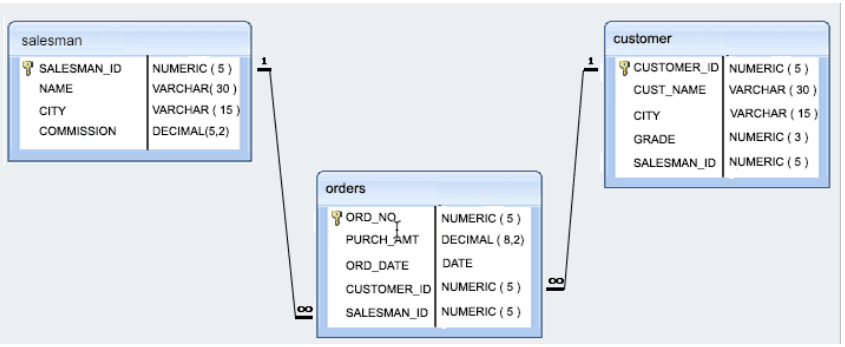


customer_id	cust_name	city	grade	salesman_id
3002	Nick Rimando	New York	100	5001
3005	Graham Zusi	California	200	5002
3004	Fabian Johnson	Paris	300	5006
3007	Brad Davis	New York	200	5001
3009	Geoff Cameron	Berlin	100	5003
3008	Julian Green	London	300	5002
3003	Jozy Altidore	Moscow	200	5007
3001	Brad Guzan	London		5005

```
SELECT * FROM customer
WHERE grade =200;
```

customer_id	cust_name	city	grade	salesman_id
3002	Nick Rimando	New York	100	5001
3005	Graham Zusi	California	200	5002
3004	Fabian Johnson	Paris	300	5006
3007	Brad Davis	New York	200	5001
3009	Geoff Cameron	Berlin	100	5003
3008	Julian Green	London	300	5002
3003	Jozy Altidore	Moscow	200	5007
3001	Brad Guzan	London		5005

COMBINING DATA




```
SELECT salesman.name AS "Salesman",
customer.cust_name, customer.city
FROM salesman,customer
WHERE salesman.city=customer.city;
```

salesman

salesman_id	name	city	commission
5001	James Hoog	New York	0.15
5002	Nail Knite	Paris	0.13
5005	Pit Alex	London	0.11
5006	Mc Lyon	Paris	0.14
5003	Lauson Hense		0.12
5007	Paul Adam	Rome	0.13

customer

customer_id	cust_name	city	grade	salesman_id
3002	Nick Rimando	New York	100	5001
3005	Graham Zusi	California	200	5002
3004	Fabian Johnson	Paris	300	5006
3007	Brad Davis	New York	200	5001
3009	Geoff Cameron	Berlin	100	5003
3008	Julian Green	London	300	5002
3001	Brad Guzan	London		5005
3003	Jozy Altidore	Moscow	200	5007

salesman

name	city
James Hoog	New York

customer

city	cust_name
New York	Nick Rimando
New York	Brad Davis

name	city
Nail Knite	Paris
Mc Lyon	Paris

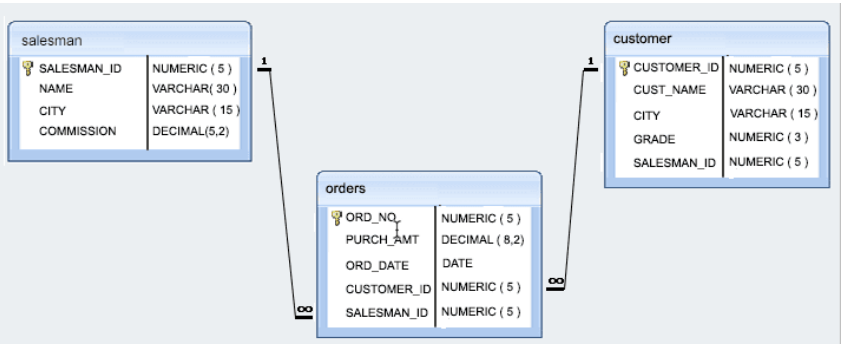
city	cust_name
Paris	Fabian Johnson

name	city
Pit Alex	London

city	cust_name
London	Julian Green
London	Brad Guzan

Salesman	cust_name	city
James Hoog	Brad Davis	New York
James Hoog	Nick Rimando	New York
Nail Knite	Fabian Johnson	Paris
Pit Alex	Brad Guzan	London
Pit Alex	Julian Green	London
Mc Lyon	Fabian Johnson	Paris

COMBINING DATA




```
SELECT a.ord_no,a.purch_amt,
b.cust_name,b.city
FROM orders a,customer b
WHERE a.customer_id=b.customer_id
AND a.purch_amt BETWEEN 500 AND 2000;
```

orders

ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.50	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.50	2012-08-17	3009	5003
70007	948.50	2012-09-10	3005	5002
70005	2400.60	2012-07-27	3007	5001
70008	5760.00	2012-09-10	3002	5001
70010	1983.43	2012-10-10	3004	5006
70003	2480.40	2012-10-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.60	2012-04-25	3002	5001

customer

customer_id	cust_name	city	grade	salesman_id
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orders

ord_no	purch_amt	ord_date	customer_id
70001	150.50	2012-10-05	3005
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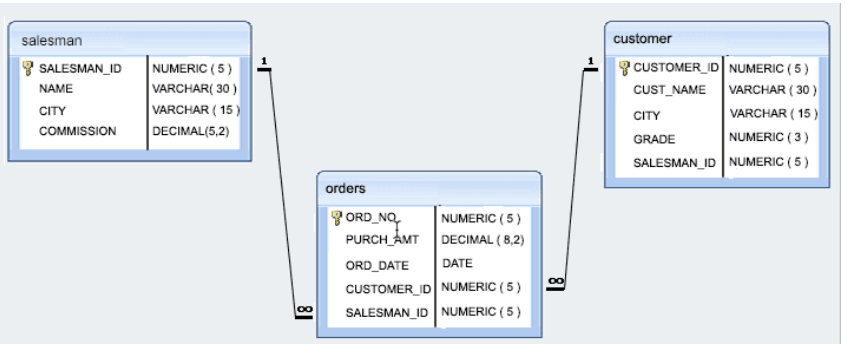
70002	65.26	2012-10-05	3002
70004	110.50	2012-08-17	3009
70007	948.50	2012-09-10	3005
70005	2400.60	2012-07-27	3007
70008	5760.00	2012-09-10	3002
70010	1983.43	2012-10-10	3004

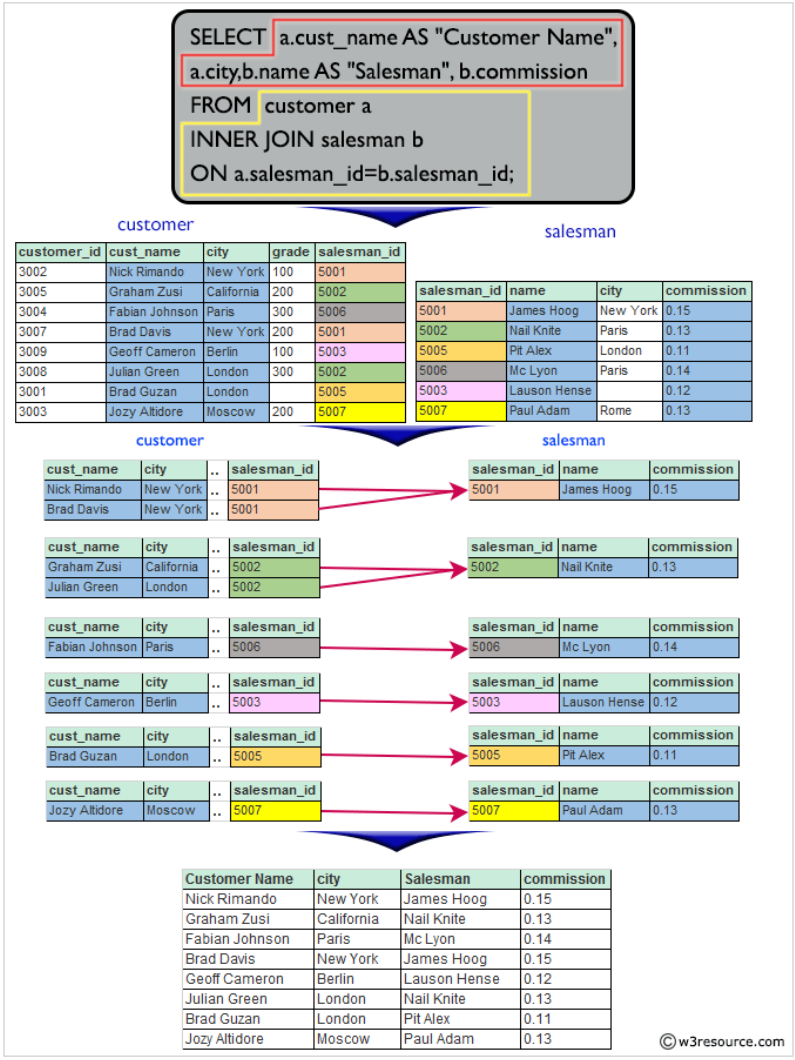
customer

customer_id	cust_name	city	grade	salesman_id
3002	Nick Rimando	New York	100	5001
3005	Graham Zusi	California	200	5002
3004	Fabian Johnson	Paris	300	5006
3007	Brad Davis	New York	200	5001
3009	Geoff Cameron	Berlin	100	5003
3008	Julian Green	London	300	5002
3001	Brad Guzan	London		5005
3003	Jozy Altidore	Moscow	200	5007

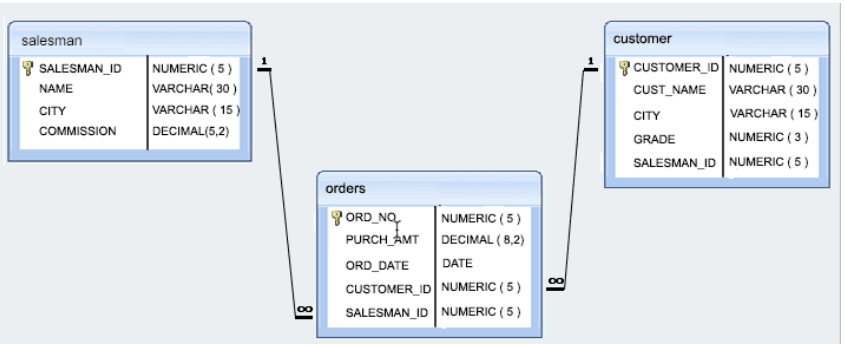
ord_no	purch_amt	cust_name	city
70007	948.50	Graham Zusi	California
70010	1983.43	Fabian Johnson	Paris

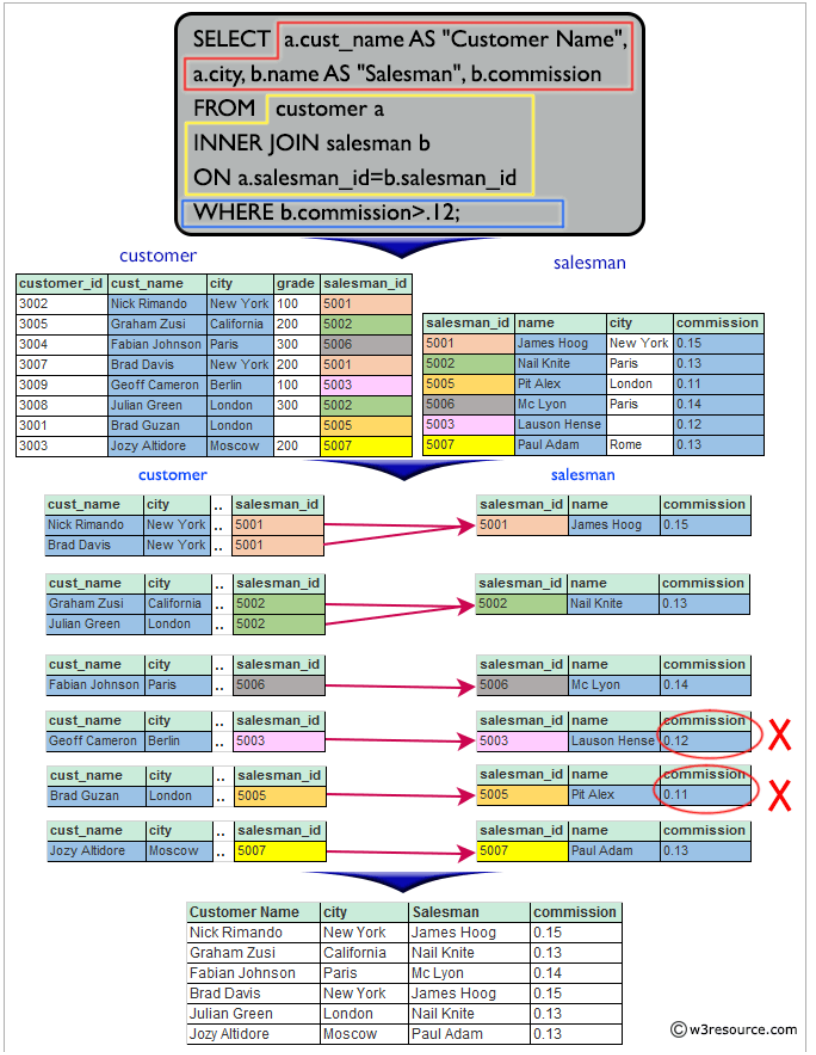
COMBINING DATA



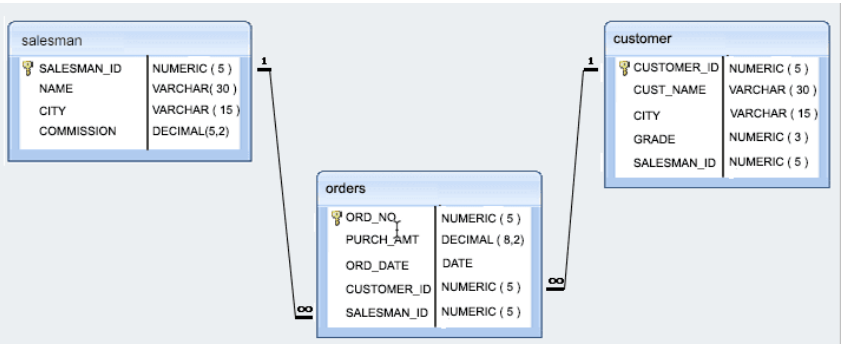


COMBINING DATA





Find the total purchase amount for all orders



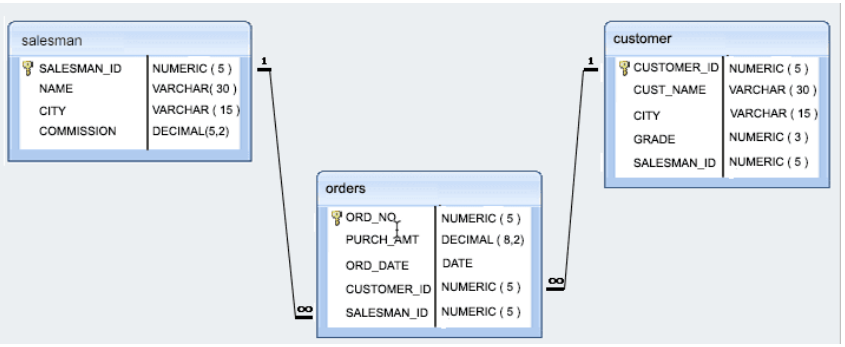
ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.50	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.50	2012-08-17	3009	5003
70007	948.50	2012-09-10	3005	5002
70005	2400.60	2012-07-27	3007	5001
70008	5760.00	2012-09-10	3002	5001
70010	1983.43	2012-10-10	3004	5006
70003	2480.40	2012-10-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.60	2012-04-25	3002	5001

```
SELECT SUM (purch_amt)
FROM orders ;
```

purch_amt
150.50
270.65
65.26
110.50
948.50
2400.60
5760.00
1983.43
2480.40
250.45
75.29
3045.60

Sum : 17541.18

Highest purchase amount ordered by the each customer



ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.50	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.50	2012-08-17	3009	5003
70007	948.50	2012-09-10	3005	5002
70005	2400.60	2012-07-27	3007	5001
70008	5760.00	2012-09-10	3002	5001
70010	1983.43	2012-10-10	3004	5006
70003	2480.40	2012-10-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.60	2012-04-25	3002	5001

```
SELECT customer_id, MAX(purch_amt)
FROM orders
GROUP BY customer_id ;
```

customer_id	purch_amt
3005	150.5
3001	270.65
3002	65.26
3009	110.5
3005	948.5
3007	2400.6
3002	5760
3004	1983.43
3009	2480.4
3008	250.45
3003	75.29
3002	3045.6

customer_id	max
3004	1983.43
3008	250.45
3001	270.65
3007	2400.6
3005	948.5
3002	5760
3009	2480.4

Gregarious Aggregates

Aggregate functions allow you to perform a calculation on a set of values to return a single value.

Aggregate Functions

The most commonly used aggregate functions are:

`AVG`	Calculates the average of a set of values
`COUNT`	Counts the rows in a specific table or view
`MIN`	Returns the minimum value in a set of values
`MAX`	Returns the maximum value in a set of values
`SUM`	Calculates the sum of a set of values

Aggregate Functions

Aggregate functions are often used with:

01 The `GROUP BY` clause

02 The `HAVING` clause

03 The `SELECT` statement

Order By Aggregates

The `ORDER BY` function:

- Is added towards the end of a query.
- Returns in an ascending order by default.
- Can also return in a descending order by adding `DESC`.
- Can limit the return by adding `LIMIT`.
- **NOTE:** Use the `ROUND` function to round up the number after the the decimal.

Pro Tip:

One important point about AGGREGATE FUNCTIONS:

The returned data is in random order!

Introduction to Subqueries

Subqueries

A subquery is nested inside a larger query. Subqueries occur in:

01 The `SELECT` statement

02 The `FROM` clause

03 The `WHERE` clause

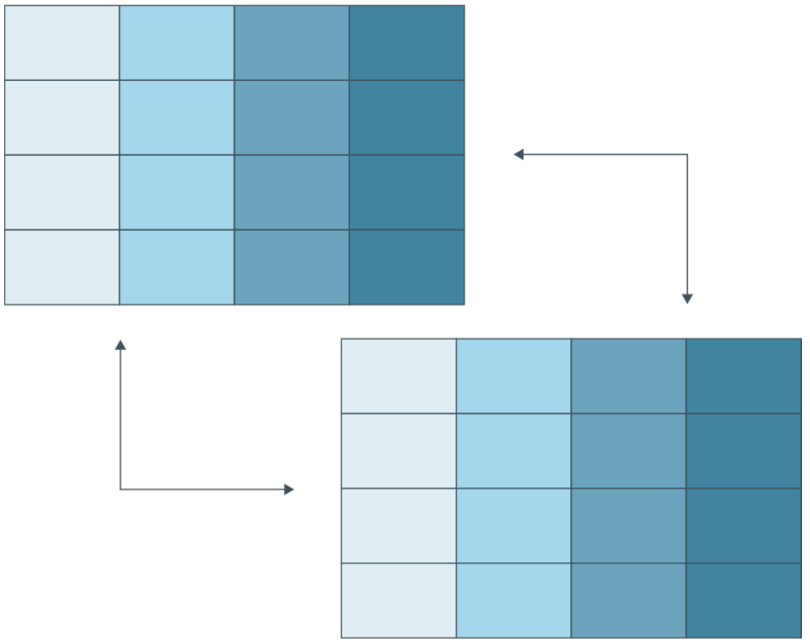
SQL Views

A **view** is a virtual table that can be created from a single table, multiple tables, or another view.

SQL Views

Views are created by using the `CREATE VIEW` statement.

Views are created from a single table, multiple tables, or another view.



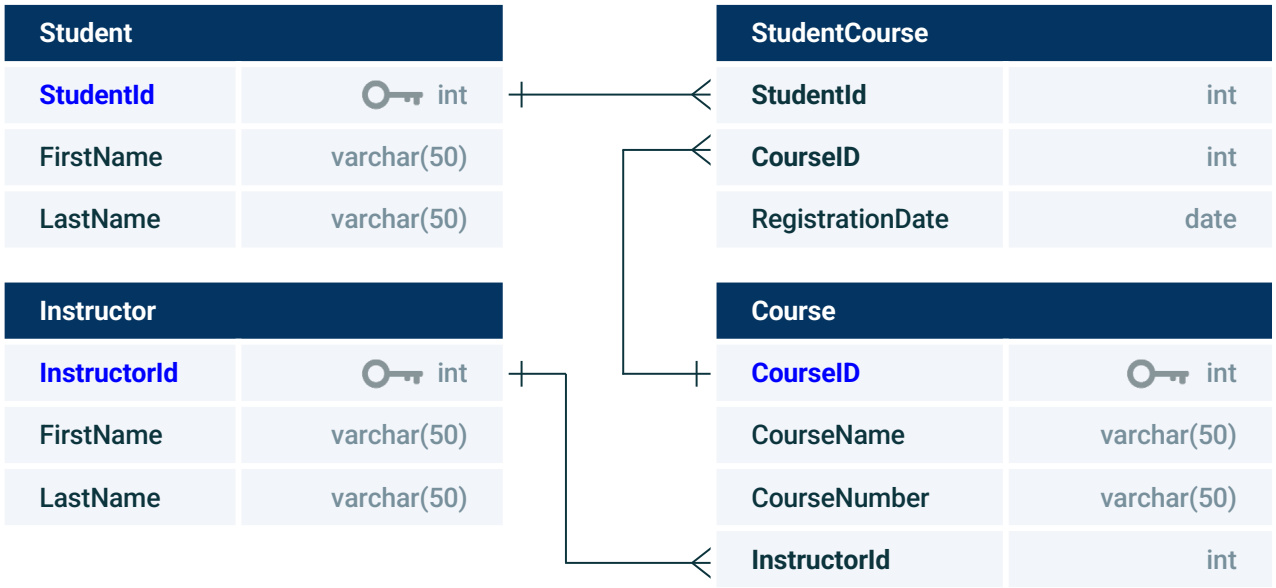
How many people have rented the film Blanket Beverly?

An **ERD** (Entity Relationship Diagram) shows the connections between the tables.

Entity Relationship Diagram

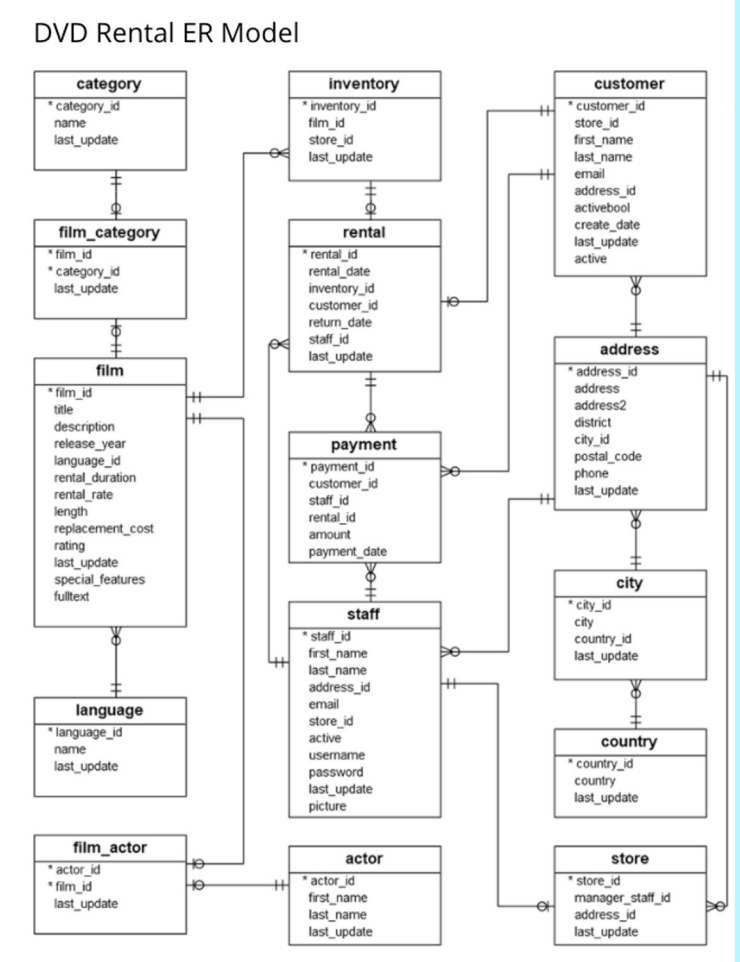
It's called an Entity Relationship Diagram because it shows:

- The entities in your data model
- The relationship between entities



Entity Relationship Diagram

The schema makes it easier to identify the tables we need as well as the keys we will use to link our subqueries.



Foreign Keys

Foreign Keys

Foreign Keys reference the primary key of another table.

Can have a different name. It does not have to be unique.

Primary Key

	A	B
1	family_id	family
2	1	Smiths
3	2	Jones

Primary Key **Foreign Key**

	A	B	C
1	child_id	family_id	children
2	11	1	Chris
3	22	1	Abby
4	33	1	Suzy

Data Relationships

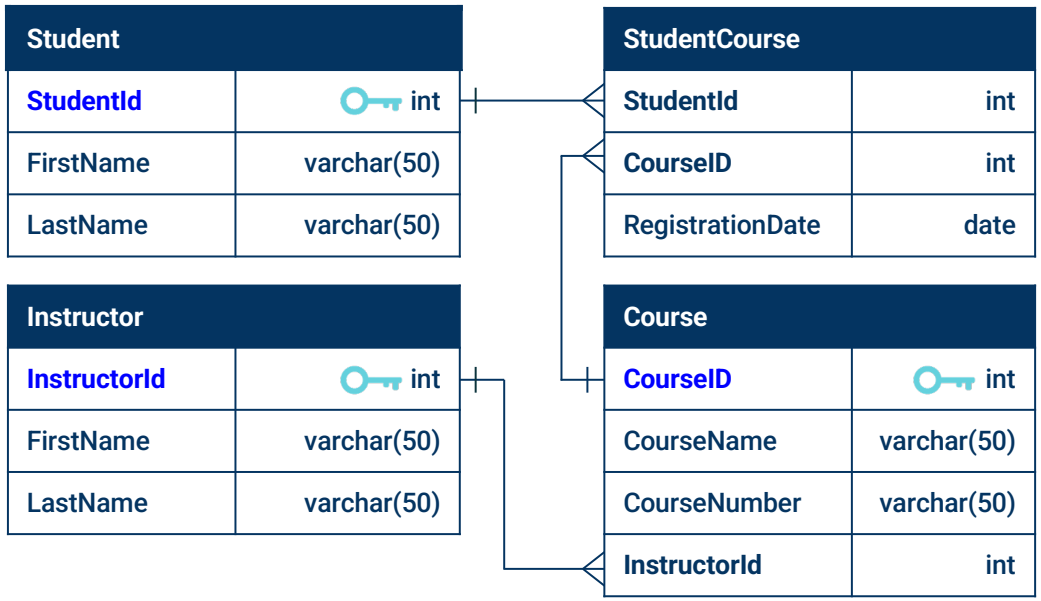
Relationships Link Tables/Entities.

Types of relationships:

01 One-to-One

02 One-to-Many

03 Many-to-Many



One-to-One Relationship

Each item in one column is linked to only one other item from the other column.

ID	Name	Social Security
1	Homer	111111111
2	Marge	222222222
3	Lisa	333333333
4	Bart	444444444
5	Maggie	555555555

Here, each person in the Simpsons family can have only one social security number.

Each social security number can be assigned only to one person.

One-to-Many Relationship

This example has two tables. The first table lists only addresses.

The second table lists each person's Social Security number and address. As before, one Social Security number is unique to one individual.

ID	Address
11	742 Evergreen Terrace
12	221B Baker Street

ID	Name	Social Security	AddressID
1	Homer	111111111	11
2	Marge	222222222	11
3	Lisa	333333333	11
4	Bart	444444444	11
5	Maggie	555555555	11
6	Sherlock	112233445	12
7	Watson	223344556	12

One-to-Many Relationship

- Each address can be associated with multiple people.
- Each person has an address.
- The two tables, joined, would look like this.

ID	Address	ID	Name	Social Security	AddressID
11	742 Evergreen Terrace	1	Homer	111111111	11
12	221B Baker Street	2	Marge	222222222	11
		3	Lisa	333333333	11
		4	Bart	444444444	11
		5	Maggie	555555555	11
		6	Sherlock	112233445	12
		7	Watson	223344556	12

Many-to-Many Relationship

- Each child can have more than one parent.
- Each parent can have more than one child.

ID	Child	ID	Parent
1	Bart	11	Homer
2	Lisa	12	Marge
3	Maggie		

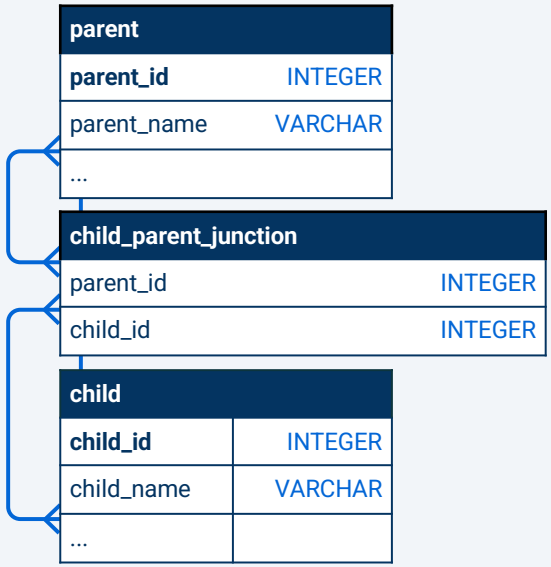
Many-to-Many Relationship

- Each child can have more than one parent.
- Each parent can have more than one child.
- The two tables are joined in a **junction table**.

ChildID	Child	ParentID	Parent
1	Bart	11	Homer
1	Bart	12	Marge
2	Lisa	11	Homer
2	Lisa	12	Marge
3	Maggie	11	Homer
3	Maggie	12	Marge

Junction Table

The junction table contains many parent_id's and many child_id's.



	parent_id integer	child_id integer
1	11	1
2	11	2
3	11	3
4	12	1
5	12	2
6	12	3

Join child and parent table to junction table ↓

	parent_name character varying (255)	child_name character varying (255)
1	Homer	Bart
2	Homer	Lisa
3	Homer	Maggie
4	Marge	Bart
5	Marge	Lisa
6	Marge	Maggie

SQL Joins

`INNER JOIN`	Returns records that have matching values in both tables.
`LEFT JOIN`	Returns all records from the left table and the matched records from the right table.
`RIGHT JOIN`	Returns all records from the right table and the matched records from the left table.
`CROSS JOIN`	Returns records that match every row of the left table with every row of the right table. This type of join has the potential to make very large tables.
`FULL OUTER JOIN`	Places null values within the columns that do not match between the two tables, after an inner join is performed.