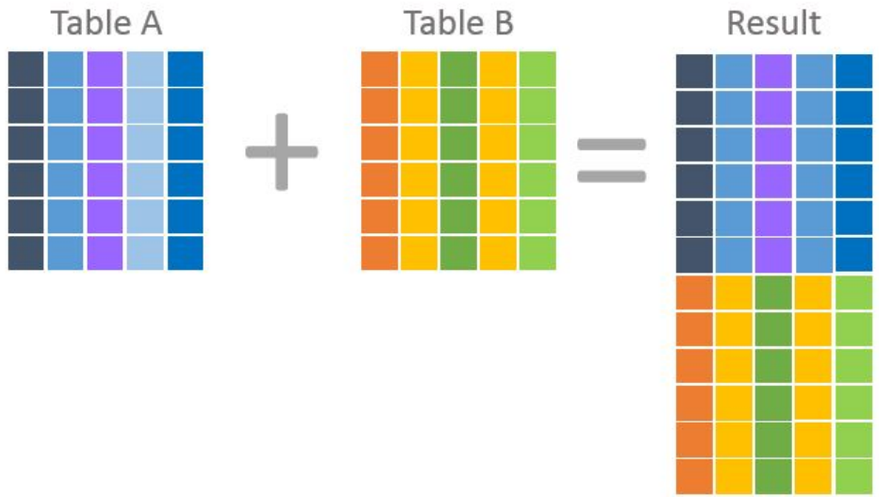
JOINS & UNIONS IN SQL

LEARNING OBJECTIVES

1. Learn the SQL tools for appending similar data together.
2. Explore combining data from different tables together.
3. Use the SQL commands `JOIN` and `UNION` to answer data questions.
4. Introduce the SQL structure to `JOIN` data from multiple sources.

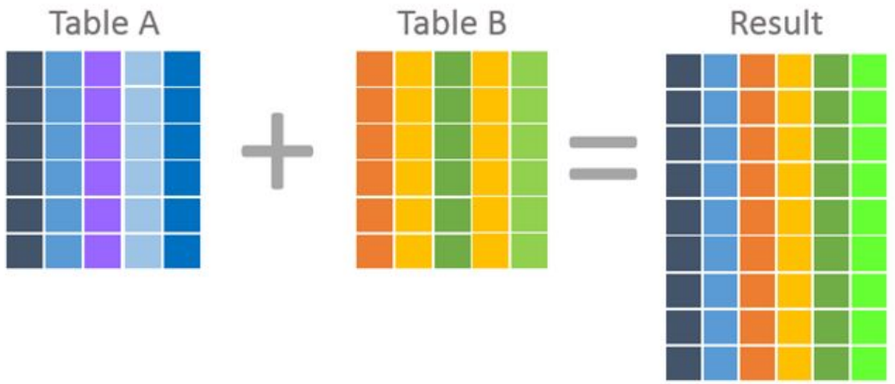
INTRODUCTION: UNIONS AND JOINS

UNIONS AND JOINS: ILLUSTRATION



A **`UNION`** merges rows of *similar* data to create a new set.

A **`JOIN`** combines columns from tables using common unique identifiers (keys).



Source: essentialSQL, https://goo.gl/FQXykj

UNIONS AND JOINS: COMPARING TABLES

DIRECTIONS

1. Navigate to the tables labeled FY17 and FY18.
2. Observe the likely meaning of each column.
3. Contrast the data type structures for both tables.
4. Make a list of similarities and differences.

DELIVERABLE

Share your observations on how this data might be combined to create meaningful business reports.

DEMO: UNIONS

UNIONS: SAMPLE CODE STRUCTURE

Let's look at some simple mock syntax for a **UNION**:

```
SELECT field1
   FROM table1
   WHERE field1= X
UNION
SELECT Field1
   FROM table2
   WHERE field1= X
ORDER BY 1
```

GUIDED PRACTICE: UNIONS

THREE TYPES OF UNIONS: MERGING TWO TABLES

We'll build three different examples of `UNIONs`:

- A table `UNION`.
- A column `UNION`.
- A combination of the two.

We'll be using the following sample HR tables for illustration:

`Employees1`

id	first_name	last_name	current_salary
2	Gabe	Moore	50000
3	Doreen	Mandeville	60000
5	Simone	MacDonald	55000

`Employees2`

id	first_name	last_name	current_salary
7	Madisen	Flateman	75000
11	Ian	Paasche	120000
13	Mimi	St. Felix	70000

THREE TYPES OF UNIONS: MERGING TWO TABLES

A **table** `UNION` includes selections from different tables:

```
SELECT * FROM Employees1 UNION SELECT * FROM Employees2
```

id	first_name	last_name	current_salary
2	Gabe	Moore	50000
3	Doreen	Mandeville	60000
5	Simone	MacDonald	55000

id	first_name	last_name	current_salary
7	Madisen	Flateman	75000
11	Ian	Paasche	120000
13	Mimi	St. Felix	70000

id	first_name	last_name	current_salary
2	Gabe	Moore	50000
3	Doreen	Mandeville	60000
5	Simone	MacDonald	55000
7	Madisen	Flateman	75000
11	Ian	Paasche	120000
13	Mimi	St. Felix	70000

THREE TYPES OF UNIONS: MERGING TWO TABLES

A **column** `UNION` is when you `UNION` columns from the same table together:

```
SELECT first_name FROM Employees1
UNION
SELECT last_name FROM Employees1
```

id	first_name	last_name	current_salary
2	Gabe	Moore	50000
3	Doreen	Mandeville	60000
5	Simone	MacDonald	55000

id	first_name
2	Gabe
3	Doreen
5	Simone
2	Moore
3	Mandeville
5	MacDonald

THREE TYPES OF UNIONS: MERGING TWO TABLES

A combination of *column* and *table* **`unions`** brings together specific columns from two different tables:

```
SELECT first_name FROM Employees1
UNION
SELECT last_name FROM Employees1
UNION
SELECT first_name FROM Employees2
UNION
SELECT last_name FROM Employees2
```

id	first_name
2	Gabe
3	Doreen
5	Simone
2	Moore
3	Mandeville
5	MacDonald
7	Madisen
11	Ian
13	Mimi
7	Flateman
11	Paasche
13	St. Felix

THREE TYPES OF UNIONS: MERGING TWO TABLES

Let's try this with our PostgreSQL database. Create a table `UNION`:

```
SELECT *
FROM FY17

UNION

SELECT *
FROM FY18
```

	fy numeric	pd numeric	store_name character (80)	week1 numeric	week2 numeric	week3 numeric	week4 numeric
1	17	2	SAN DIEGO	8000.715479	7741.061154	1400.657862	4112.872637
2	17	2	VANCOUVER	7293.769182	1447.159002	9092.626357	5025.4913
3	17	2	SEATTLE	6692.497933	2181.314618	5641.401526	6082.684282
4	18	2	SAN FRANCISCO	627.9312729	9142.667937	3760.147	5391.33793
5	18	2	SAN DIEGO	1754.959568	3803.757709	5687.76688	8219.527173
6	17	2	SAN DIEGO	2558.010244	3760.342741	873.4542454	7541.113465
7	17	2	PORTLAND	7569.060961	5415.029643	767.8186051	172.2430083
8	18	2	PORTLAND	8729.988537	306.43882	3150.983333	4198.229664
9	17	2	DALLAS	266.472034	5698.658564	1045.834247	7762.222799
10	18	2	SEATTLE	5869.439661	6595.887082	5954.010546	4746.064601
11	17	2	PORTLAND	5351.793961	2485.721046	7425.021263	7306.720805
12	18	2	VANCOUVER	3913.520693	2583.005	9768.463565	4214.983293
13	18	2	PORTLAND	1301.496764	3956.17356	9127.618963	9779.973338
14	17	2	PHOENIX	372.3659485	8900.969922	6737.209742	2471.024603
15	18	2	SEATTLE	6789.640585	9194.083103	8282.101838	5744.869032
16	18	2	SAN DIEGO	1710.179314	9442.510897	5838.668937	4441.577408
17	18	2	DALLAS	6103.293083	6217.776958	2648.601179	4531.9008
18	18	2	PORTLAND	1002.225137	5125.229579	1245.442398	7059.23758
19	18	2	PHOENIX	9349.958989	9769.625787	9605.303381	4318.069613
20	17	2	SAN FRANCISCO	1888.715186	8917.598135	7549.76383	761.8372
21	17	2	SEATTLE	8431.070306	753.2214114	507.5352884	2085.558181

THREE TYPES OF UNIONS: MERGING TWO TABLES

Next, create a **column** UNION:

```
SELECT FY, PD, STORE_NAME, WEEK1
FROM FY17
UNION
SELECT FY, PD, STORE_NAME, WEEK2
FROM FY17
```

	fy numeric	pd numeric	store_name character (80)	week1 numeric
1	17	2	SEATTLE	6692.497933
2	17	2	SEATTLE	8431.070306
3	17	2	PORTLAND	5351.793961
4	17	2	PORTLAND	7569.060961
5	17	2	PORTLAND	3943.511757
6	17	2	VANCOUVER	7293.769182
7	17	2	SAN FRANCISCO	1888.715186
8	17	2	SAN DIEGO	2558.010244
9	17	2	SAN DIEGO	8000.715479
10	17	2	DALLAS	266.472034
11	17	2	PHOENIX	372.3659485

UNION

	fy numeric	pd numeric	store_name character (80)	week2 numeric
1	17	2	SEATTLE	2181.314618
2	17	2	SEATTLE	753.2214114
3	17	2	PORTLAND	2485.721046
4	17	2	PORTLAND	5415.029643
5	17	2	PORTLAND	7118.030799
6	17	2	VANCOUVER	1447.159002
7	17	2	SAN FRANCISCO	8917.598135
8	17	2	SAN DIEGO	3760.342741
9	17	2	SAN DIEGO	7741.061154
10	17	2	DALLAS	5698.658564
11	17	2	PHOENIX	8900.969922

	fy numeric	pd numeric	store_name character (80)	week1 numeric
1	17	2	PORTLAND	3943.511757
2	17	2	VANCOUVER	7293.769182
3	17	2	SEATTLE	8431.070306
4	17	2	SAN DIEGO	2558.010244
5	17	2	PHOENIX	8900.969922
6	17	2	PORTLAND	2485.721046
7	17	2	SEATTLE	2181.314618
8	17	2	SAN DIEGO	7741.061154
9	17	2	VANCOUVER	1447.159002
10	17	2	PHOENIX	372.3659485
11	17	2	PORTLAND	5415.029643
12	17	2	SAN FRANCISCO	8917.598135
13	17	2	DALLAS	266.472034
14	17	2	DALLAS	5698.658564
15	17	2	SEATTLE	753.2214114
16	17	2	PORTLAND	5351.793961
17	17	2	SEATTLE	6692.497933

THREE TYPES OF UNIONS: MERGING TWO TABLES

A combination of column and table UNIONS:

```
SELECT FY, PD, STORE_NAME, WEEK1 FROM FY17
UNION
SELECT FY, PD, STORE_NAME, WEEK2 FROM FY17
UNION
SELECT FY, PD, STORE_NAME, WEEK3 FROM FY17
UNION
SELECT FY, PD, STORE_NAME, WEEK4 FROM FY17
UNION
SELECT FY, PD, STORE_NAME, WEEK1 FROM FY18
UNION
SELECT FY, PD, STORE_NAME, WEEK2 FROM FY18
UNION
SELECT FY, PD, STORE_NAME, WEEK3 FROM FY18
UNION
SELECT FY, PD, STORE_NAME, WEEK4 FROM FY18
ORDER BY 1,2,3
```

	fy numeric	pd numeric	store_name character (80)	week1 numeric
35	17	2	SEATTLE	507.5352884
36	17	2	SEATTLE	8431.070306
37	17	2	SEATTLE	6692.497933
38	17	2	SEATTLE	6082.684282
39	17	2	SEATTLE	5641.401526
40	17	2	SEATTLE	2181.314618
41	17	2	VANCOUVER	5025.4913
42	17	2	VANCOUVER	7293.769182
43	17	2	VANCOUVER	9092.626357
44	17	2	VANCOUVER	1447.159002
45	18	2	DALLAS	2648.601179
46	18	2	DALLAS	6217.776958
47	18	2	DALLAS	6103.293083
48	18	2	DALLAS	4531.9008
49	18	2	PHOENIX	4318.069613
50	18	2	PHOENIX	9605.303381
51	18	2	PHOENIX	9769.625787
52	18	2	PHOENIX	9349.958989
53	18	2	PORTLAND	4198.229664

UNION RULES

Remember these **four** rules when using `UNION`:

1. You must match the number of columns and they must be of compatible data types.
2. You can only have one `ORDER BY` at the bottom of your full `SELECT` statement.
3. `UNION` removes **exact** duplicates; `UNION ALL` allows duplicates.
4. Conditions between `UNION SELECT` statements should match.

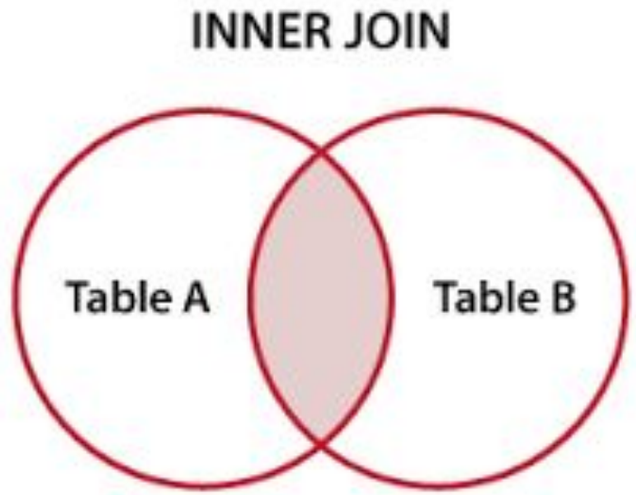
Pro Tip: While you may find yourself altering these rules in practice, keep in mind that this may damage your data integrity.

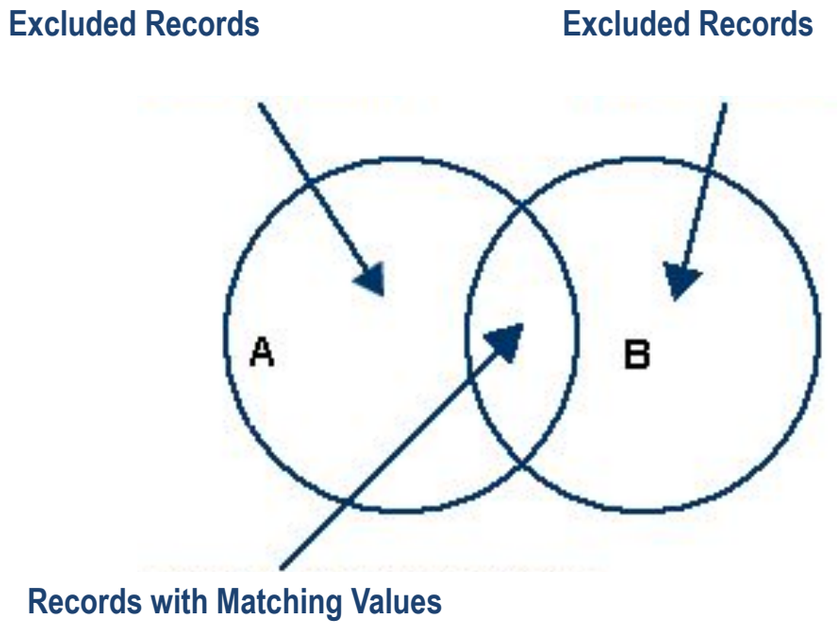
INTRODUCTION: JOINS

JOINS

SQL **JOIN**s and Excel's **VLOOKUP** command have similar purposes.

They both connect data sources together in order to use information from both tables to display a desired result.

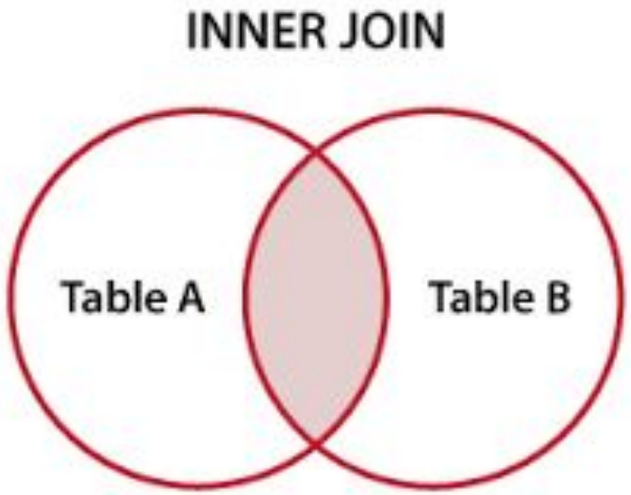


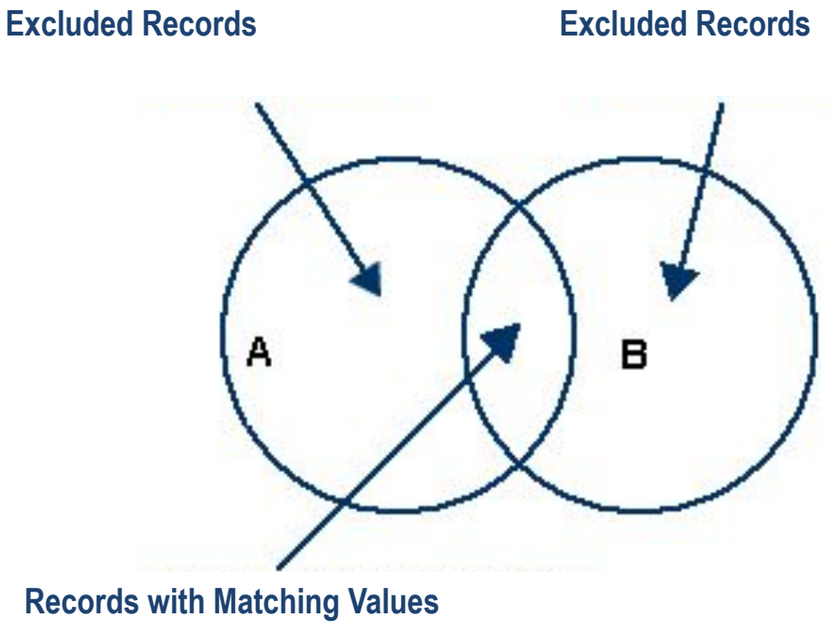


JOINS

For large relational or object-relational databases, a **`JOIN`** enables tables to be connected using common columns, which serve as unique identifiers, or **`KEYS`**.

We'll start by looking at some inner **`JOIN`**s.





DEMO:
JOIN SYNTAX

JOINS SYNTAX, EXPLAINED

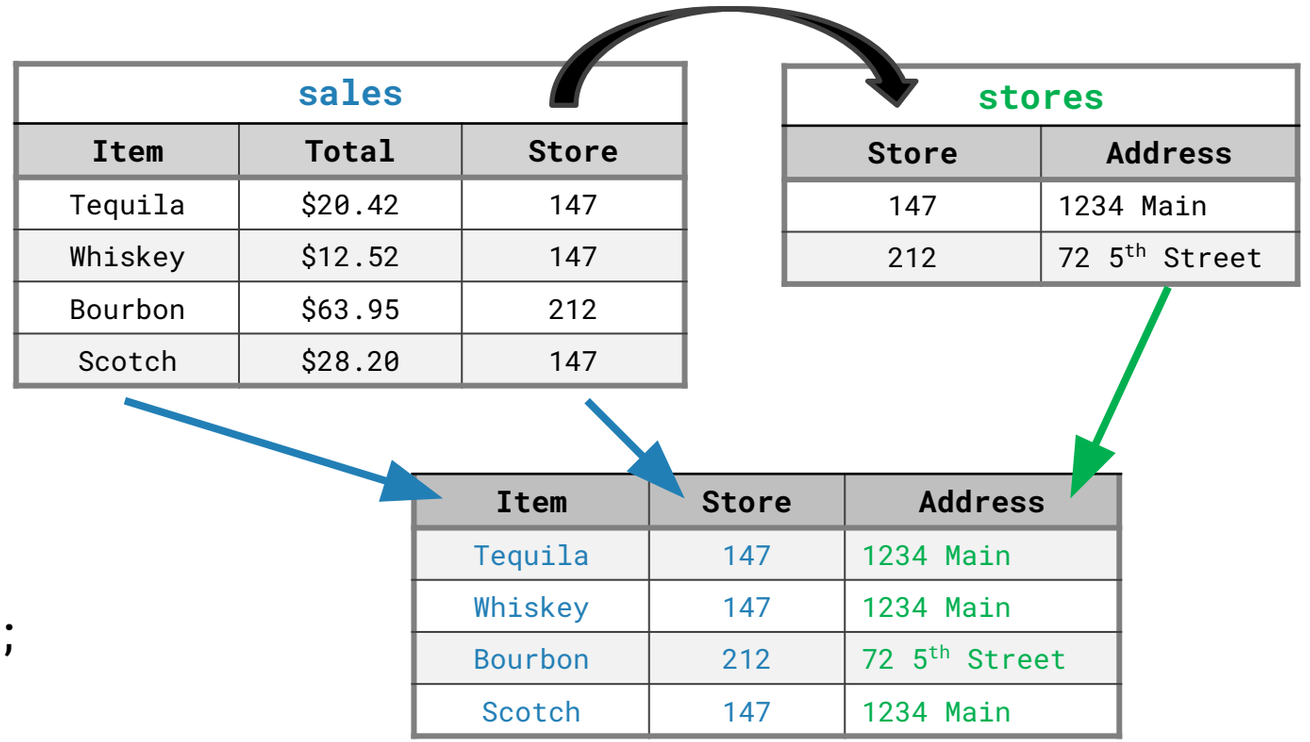
First ⇨ Identify which columns of information you are targeting.
Second ⇨ Identify the table from which to retrieve information.
Third ⇨ Specify the **keys**, or common columns that you wish to join together.

```
SELECT
    sales.Item,
    sales.Store,
    stores.Address

FROM
    sales

INNER JOIN stores

    ON sales.store = stores.store;
```



JOINS SYNTAX, EXPLAINED

Each column name must have a prefix that specifies its source. Labeling is accomplished by writing out the source table name **or** by using an **ALIAS**.

ALIASES are designated in the **FROM** statement.

```
SELECT
     stores.store,
     sales.item,
     sales.total

FROM
     sales

INNER JOIN stores

     ON sales.store = stores.store;
```

```
SELECT
     b.store,
     a.item,
     a.total
FROM
     sales a

INNER JOIN stores b

     ON a.store = b.store;
```

JOINS SYNTAX, EXPLAINED

When you create a **JOIN**, each table can have an **ALIAS** and each COLUMN is connected to the TABLE by the **ALIAS**.

An **ALIAS** is a shorthand name given to tables or columns in a table that you intend to reference repeatedly. Here, each column is connected to the table via an **ALIAS**.

table1 a	→a.column1	table1 uses the alias a.
table2 b	→b.column4	table2 uses the alias b.

JOINS SYNTAX, EXPLAINED

Next, specify the type of `JOIN` you want. An `INNER JOIN` is used by default.

Specify the connection, by column name, on which you want to link tables.

`ON a.column_name1 = b.column_name4` → With alias for source table.
`USING(column_name)` → Only if the columns have **same** name in each table.

GUIDED PRACTICE: JOINING SALES TO PRODUCTS

JOINING SALES TO PRODUCTS

EXERCISE

Let's alter this code a bit so it will work better:

```
SELECT b.item_no, b.item_description, a.total
FROM  the Sales table and the Products table.
```

Next, write a query to perform the following:

1. Find the common field on which to `JOIN` them.
2. Limit results to the first 100

JOINING SALES TO PRODUCTS

Solution:

```
SELECT b.item_no,b.item_description,a.total
FROM sales a
INNER JOIN products b
ON a.item = b.item_no
LIMIT 100;
```

JOINING SALES TO STORES

EXERCISE

Write a query to discover which `DISTINCT` products were sold in Mason City, IA.

1. Return the product description, category, and store address columns.
2. Qualify `DISTINCT`
3. Select appropriately aliased items `FROM` the Sales and Stores tables.
4. Connect the matching columns with the `USING` structure.

JOINING SALES TO STORES

EXERCISE

Sample Solution: DISTINCT products in Mason City, IA

```
SELECT DISTINCT a.description, a.category_name,
b.store_address
FROM sales a
INNER JOIN stores b
ON a.store = b.store
WHERE b.store_address LIKE '%Mason City%';
```

GUIDED PRACTICE: JOINING MULTIPLE TABLES

JOINING MULTIPLE TABLES

Here's an example of joining multiple tables together. Notice that the code repeats itself.

Tip: It can be helpful to sketch and wireframe how your `JOIN`s will relate on a piece of paper before coding.

```
SELECT
   b.field1, a.field2, a.field3, c.field4
FROM table1 a
INNER JOIN table2 b
   ON a.field1 = b.field1
INNER JOIN table3 c
   ON a.field1 = c.field1
ORDER BY b.field1
```

INDEPENDENT PRACTICE: JOINING MULTIPLE TABLES

JOINING MULTIPLE TABLES: PRACTICE NO. 1

EXERCISE

Using Sales as our primary table, create links to all of the other tables in the Iowa Liquor Sales Database. The result should be one query with several `JOIN`s.

Before going into SQL, practice wireframing your `JOIN`s on a piece of paper.

Your query should:

1. Include county from the County table, store from the Stores table, store name from the Stores table, item name, case_cost from the Products table, and total from the Sales table.
2. Limit results to 1,000.

JOINING MULTIPLE TABLES: PRACTICE NO. 1

EXERCISE

Solution query:

```
SELECT d.county, a.store, b.name,  a.item,
c.case_cost, a.total
FROM sales a
INNER JOIN stores b
ON a.store=b.store

INNER JOIN products c
ON a.item=c.item_no

INNER JOIN counties d
ON a.county = d.county
LIMIT 1000;
```

JOINING MULTIPLE TABLES: PRACTICE NO. 2

EXERCISE

Using Sales as our primary table, create links to the Products and Stores tables within the Iowa Liquor Sales Database (several `INNER JOINS`).

Before proceeding, plan your JOINs out in a wireframe.

Your query should:

1. List the store number (from Sales), category_name (from Sales), and two aggregated columns: average bottle_price (from Products) and average total price (from Sales).
2. Use a compounded `WHERE` clause to limit the calculations to the sales of tequila (category_name from Sales) from active stores in Mason City, Iowa.
3. Group and sort the data by the store number.

JOINING MULTIPLE TABLES: PRACTICE NO. 2

EXERCISE

Desired data output:

Data Output | Explain | Messages | History

	store integer	category_name text	avg_cost numeric	avg_sales_price numeric
1	2515	TEQUILA	13.20	164.51
2	2582	TEQUILA	13.21	140.72
3	2652	TEQUILA	13.19	146.68
4	3528	TEQUILA	13.75	214.64
5	3713	TEQUILA	12.96	189.00
6	4104	TEQUILA	10.02	169.38
7	4367	TEQUILA	9.82	53.85
8	4372	TEQUILA	12.25	220.44
9	4376	TEQUILA	11.12	71.31
10	4615	TEQUILA	13.85	184.77
11	4755	TEQUILA	10.49	188.76
12	4955	TEQUILA	12.07	77.03
13	5034	TEQUILA	13.28	73.84

JOINING MULTIPLE TABLES: PRACTICE NO. 2

EXERCISE

Solution query without aliases:

```
SELECT sales.store, sales.category_name,
   ROUND(AVG(CAST(products.bottle_price AS DEC)),2) AS avg_cost,
   ROUND(AVG(sales.total),2) AS avg_sales_price
FROM sales
INNER JOIN products
   ON sales.item = products.item_no
INNER JOIN stores
   ON stores.store = sales.store
WHERE sales.category_name LIKE '%TEQUILA%' AND
   stores.store_address LIKE '%Mason City%' AND
   store_status='A'
GROUP BY sales.store, sales.category_name
ORDER BY 1;
```

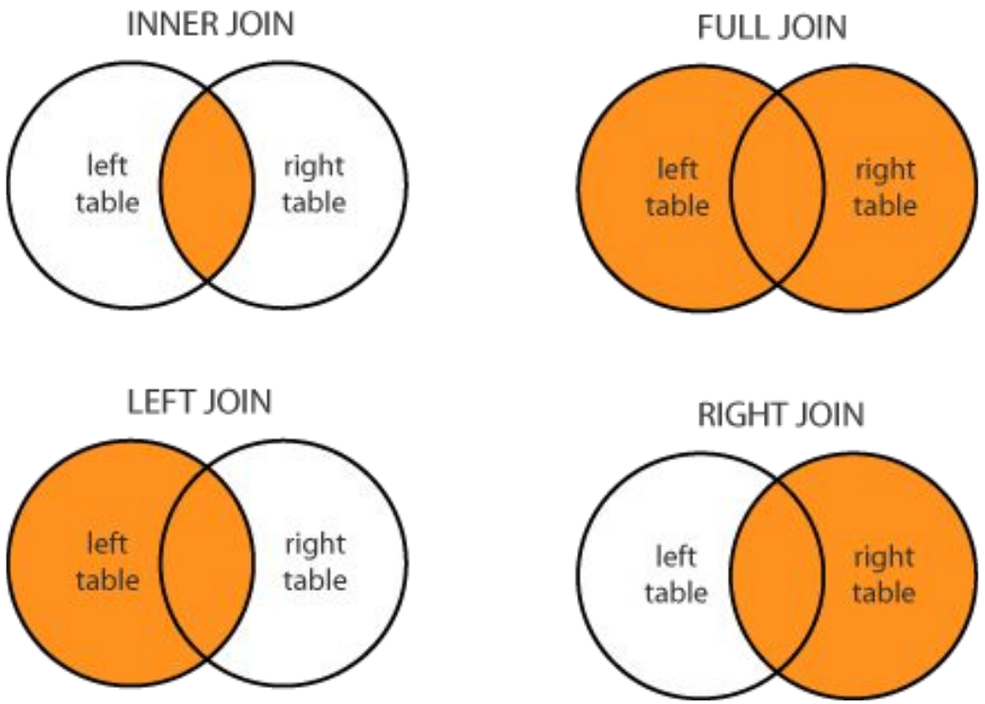
CONCLUSION

RECAP UNIONS AND JOINS

UNIONS and **JOINS** are just a few ways to connect multiple tables.

Next, we'll learn more about different types of **JOINS**, where you can prioritize one table and specify selected parts of another table for your output.

We'll cover this tomorrow!



WHAT ELSE HAVE WE COVERED?

In today's lesson, we learned how to:

1. Explain some SQL methods for appending similar data together.
2. Explore ways to combine data from different tables together.
3. Use the SQL commands `JOIN` and `UNION` to answer data questions.
4. Apply `JOINs` to connect data from multiple sources.

JOINS & UNIONS IN SQL

DIRECTIONS

1. Pair up and take 10 minutes to discuss:
   - Key takeaways from today.
   - What you can do to make these takeaways actionable and valuable for your teams.
     - Thought starters: Better knowledge of keys in databases, aligning with database teams on data organization.

DELIVERABLE

Be prepared to share your answers with the class.

JOINS & UNIONS IN SQL

Q&A

RESOURCES

RESOURCES

- Microsoft reference material on UNIONs: https://docs.microsoft.com/en-us/sql/t-sql/language-elements/set-operators-union-transact-sql
- INNER JOIN tutorial: http://www.sqltutorial.org/sql-inner-join/
- “What is the Difference Between a JOIN and a UNION?”: https://www.essentialsql.com/what-is-the-difference-between-a-join-and-a-union/
- “What is the difference between a primary and unique key?” https://www.essentialsql.com/primary-and-unique-key/

CREDITS

UNION and JOIN graphical illustration from EssentialSQL.com: https://goo.gl/FQXykj.