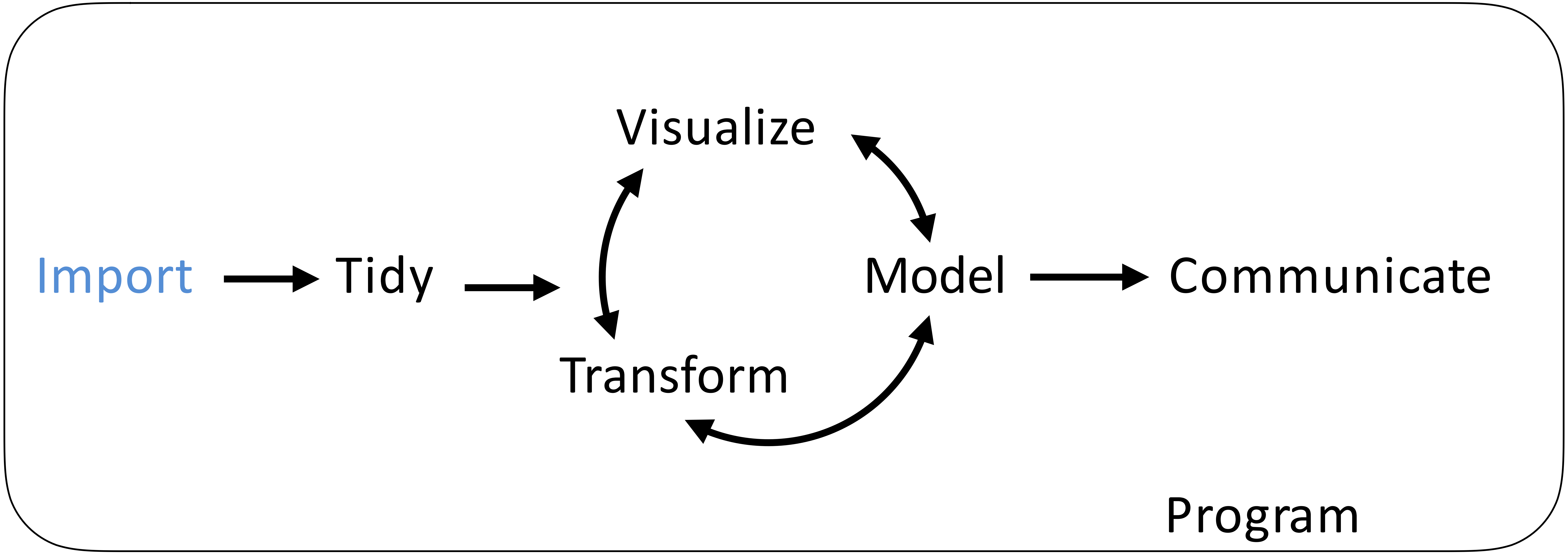
Import

DBI

"I ~~rob banks~~ use databases because its where the ~~money~~ data is."

–Willie Sutton

(Applied) Data Science



Import

Tidy

Visualize

Transform

Model

Communicate

Program

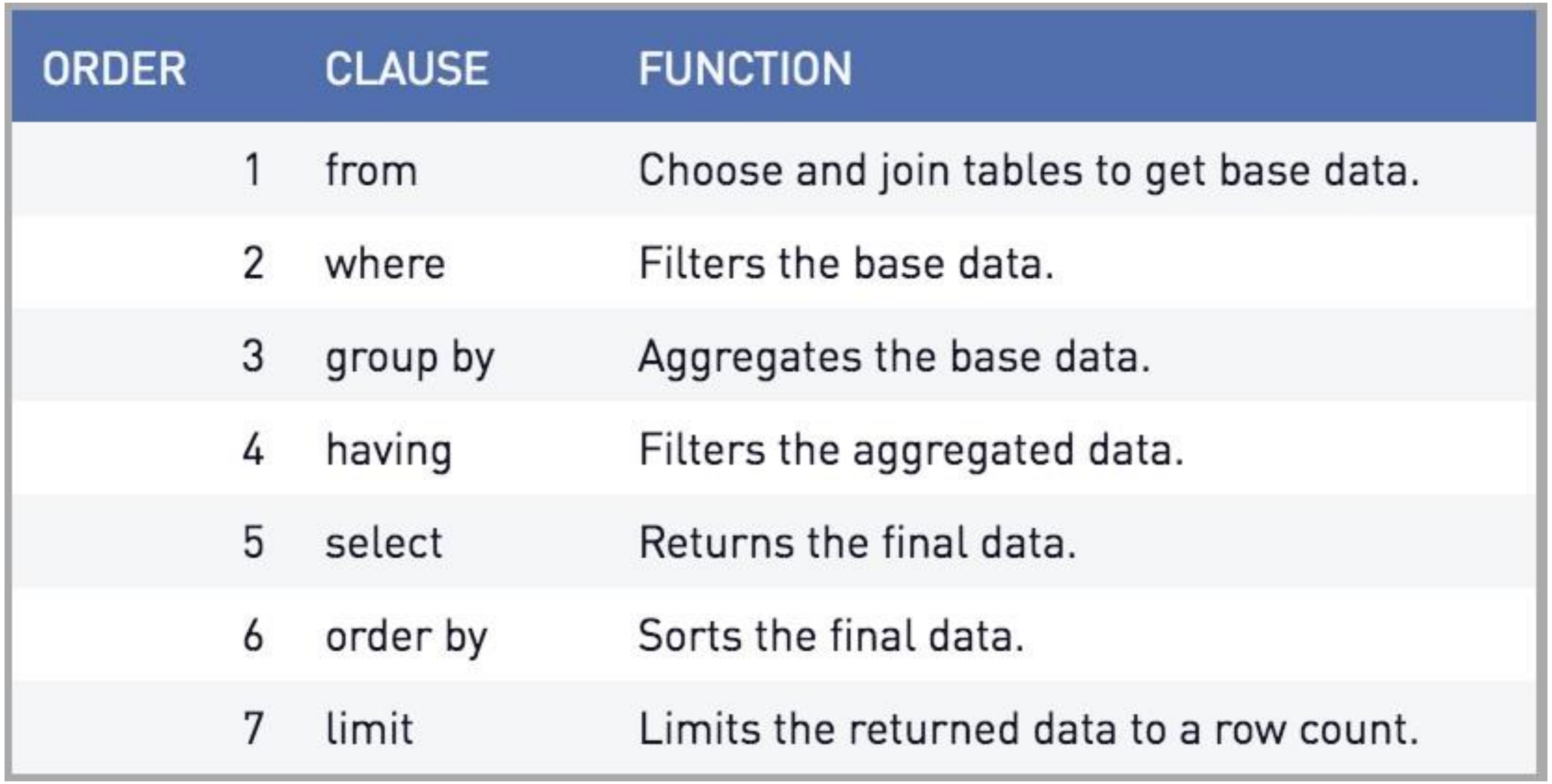
SQL

“SQL is a domain specific language used in programming and … data held in a relational database management system”

–Wikipedia

Structuring a Query

QUERIES



ORDER	CLAUSE	FUNCTION
1	from	Choose and join tables to get base data.
2	where	Filters the base data.
3	group by	Aggregates the base data.
4	having	Filters the aggregated data.
5	select	Returns the final data.
6	order by	Sorts the final data.
7	limit	Limits the returned data to a row count.

Source: periscope data

EXERCISE

- Open DBeaver and connect to the Data Warehouse
- Build a query that selects all of the air quality readings from the Health_AVData_AmbAqiSiteHistory table.
  - Hint: The Data Warehouse is a Microsoft SQL database, so any web searches you do should be based off that syntax

SOLUTION

```
SELECT * FROM Master.Health_AVData_AmbAqiSiteHistory
```

WHERE

BETWEEN … AND

- BETWEEN
  - *Grab Values between two other values, like IN but for numeric values*
  - *Works like < and >*

```
SELECT column_name(s)
FROM table_name
WHERE column_name BETWEEN value1
      AND value2;
```

IN STATEMENTS

- Useful for when you have an input that returns multiple
- This works the same way %in% does in R
- Checks to see if the value in the column matches *any* of the values in your list

```
SELECT column_name(s)
FROM table_name
WHERE column_name IN (value1, value2, ...)
```

EXERCISE

- Open DBeaver and connect to the Data Warehouse
- This time let’s target Dog Licenses (Treasurer_licenseAC_vw_DogLicenseSearchData)
- Use the BETWEEN function as a WHERE filter to get dog licenses that expired in the years 2015 to 2018.
  - Stretch goal: Use the IN Filter to only get licenses for MIXED, WELSH CORGI CARDIGA and SHIBA INU Breeds.

SOLUTION

```
SELECT * FROM Master.Treasurer_licenseAC_vw_DogLicenseSearchData
WHERE ExpYear BETWEEN 2015 AND 2018
```

```
SELECT * FROM
Master.Treasurer_licenseAC_vw_DogLicenseSearchData
WHERE ExpYear BETWEEN 2015 AND 2018 AND
Breed IN ('MIXED', 'WELSH CORGI CARDIGA', 'SHIBA INU')
```

Pop Quiz

Tidyverse equivalent?

filter()

SELECT Functions and GROUP BY

SQL FUNCTIONS

- Sometimes you don’t just want the raw data
- You want to aggregate the data in SQL before you load it into R
    - Use another server to do the heavy lifting so you don’t have to!
- This is where

DISTINCT

- DISTINCT()
  - Every unique value of a column.
  - Placing TWO columns inside will return unique instances of both columns:

```
DISTINCT(“REQUEST_TYPE”,  “DEPARTMENT”)
```

Pop Quiz

Tidyverse equivalent?

distinct()

MATH FUNCTIONS

- MIN()
  - Returns minimum value in a column(s)
- MAX()
  - Return max value in a column(s)

Pop Quiz

Tidyverse equivalent?

min(), max()

COUNT, AVERAGE, SUM

- COUNT() - returns the number of rows that your query returns
  - SELECT COUNT(column_name)
    FROM table_name

- AVG() - returns the average value of a numeric column.
  - SELECT AVG(column_name)
    FROM table_name

- SUM() - function returns the total sum - numeric columns only
  - SELECT SUM(column_name)
    FROM table_name

Pop Quiz

R/Tidyverse equivalents?

n(), mean(), sum()

GROUP BY

- This is helpful for when you are doing any of the summary functions mentioned in the previous slides. (COUNT, SUM, MAX etc)
- Any column that isn’t handled with a function should be included in your GROUP BY

```
SELECT column_name(s), max(column_name)
FROM table_name
WHERE condition
GROUP BY column_name(s)
```

Pop Quiz

Tidyverse equivalent?

group_by()

EXERCISE

- Open Dbeaver and connect to the Data Warehouse
  - Build a query that gives the Max number AQI for each Air Quality Site and Parameter
    - Hint: Group by SiteName and ResponsibleParameterName
  - Stretch Goal: Give each year’s max
    - Hint: Look up documentation for the DATEPART() SQL Server function

SOLUTION

```
SELECT MAX(IndexValue) MaxAqi,
       SiteName,
       ParameterName
FROM Master.Health_AVData_AmbAqiSiteHistory
GROUP BY SiteName,
       ParameterName
```

```
SELECT MAX(IndexValue) MaxAqi,
       DATEPART(year, SystemStandardizedDate) Year,
       SiteName,
       ParameterName
FROM Master.Health_AVData_AmbAqiSiteHistory
GROUP BY SiteName,
       ParameterName,
       DATEPART(year, SystemStandardizedDate)
```

Other Functions

CASE

- CASE statements are for when you want to return categorical values based off of something else.

```
SELECT OrderID, Quantity,
CASE
    WHEN Quantity > 30 THEN "The quantity is greater than 30"
    WHEN Quantity = 30 THEN "The quantity is 30"
    ELSE "The quantity is under 30"
END AS QuantityText
FROM OrderDetails;
```

Pop Quiz

Tidyverse equivalent?

```
case_when()
```

CONCAT

- CONCAT()
  - This is mostly used when you have multiple columns you need.
  - May look different depending on DB server

```
SELECT CONCAT(column1, " ", column2) AS ConcatenatedString;

                              OR

SELECT column1|| " “ || column2 AS ConcatenatedString;
```

Pop Quiz

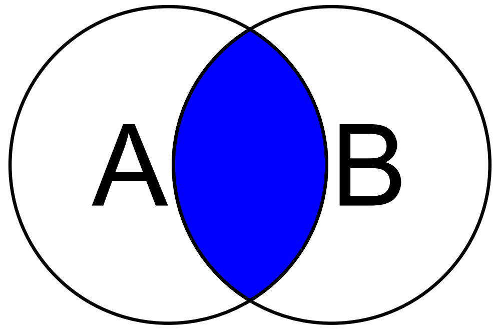
R equivalent?

paste()/paste0()

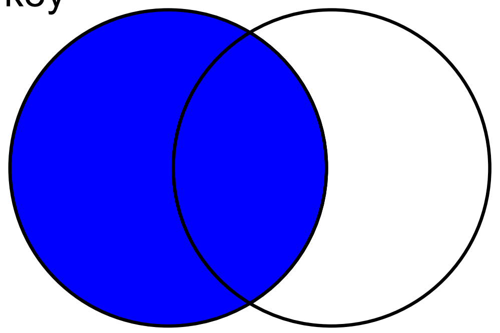
JOINS

SQL JOINS

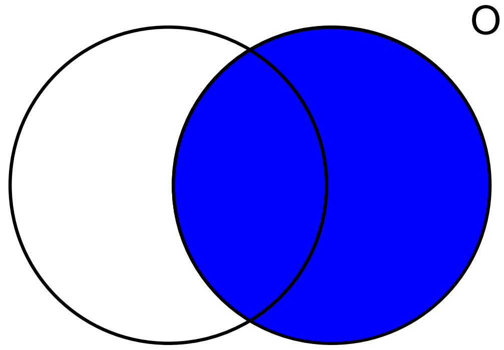
```sql
SELECT <fields>
FROM TableA A
INNER JOIN TableB B
ON A.key = B.key
```

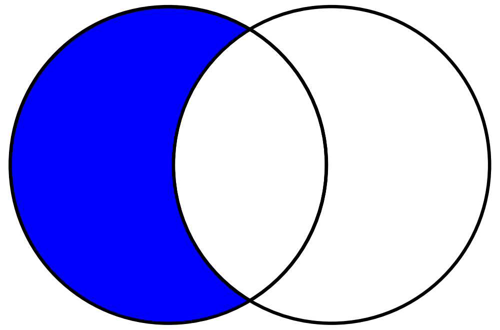


```sql
SELECT <fields>
FROM TableA A
LEFT JOIN TableB B
ON A.key = B.key
```

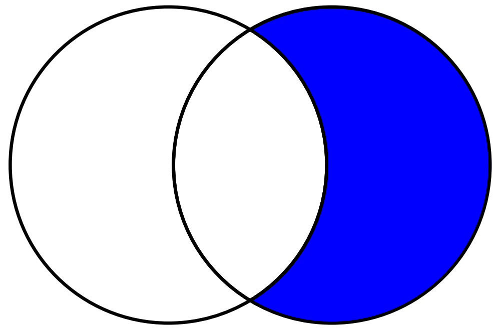


```sql
SELECT <fields>
FROM TableA A
RIGHT JOIN TableB B
ON A.key = B.key
```

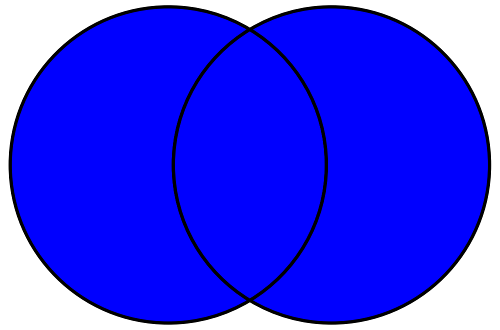




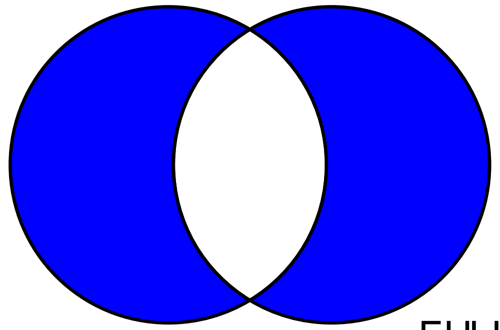
```sql
SELECT <fields>
FROM TableA A
LEFT JOIN TableB B
ON A.key = B.key
WHERE B.key IS NULL
```



```sql
SELECT <fields>
FROM TableA A
RIGHT JOIN TableB B
ON A.key = B.key
WHERE A.key IS NULL
```



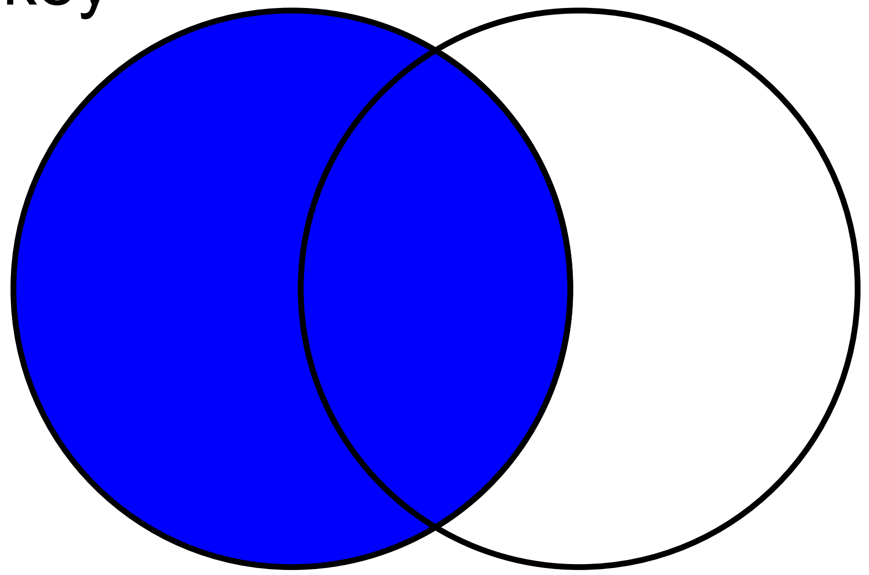
```sql
SELECT <fields>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.key = B.key
```



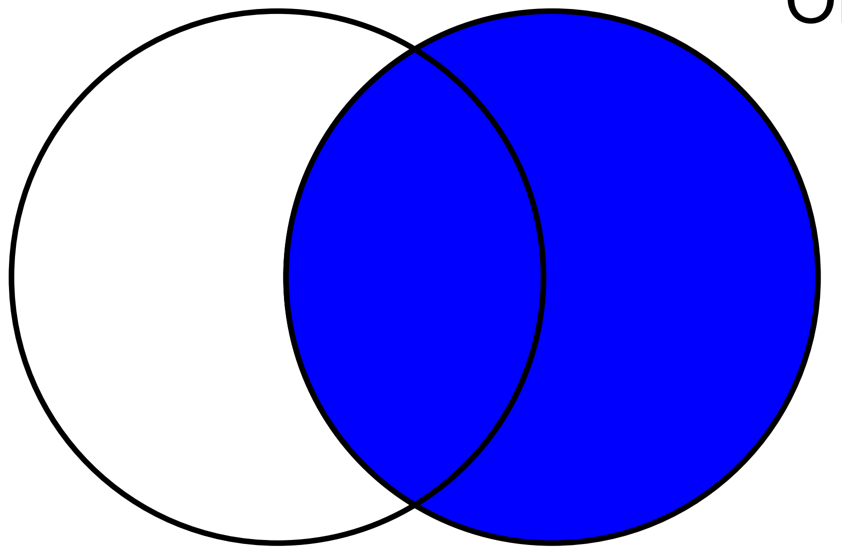
```sql
SELECT <fields>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.key = B.key
WHERE A.key IS NULL
OR B.key IS NULL
```

Left/Right Join

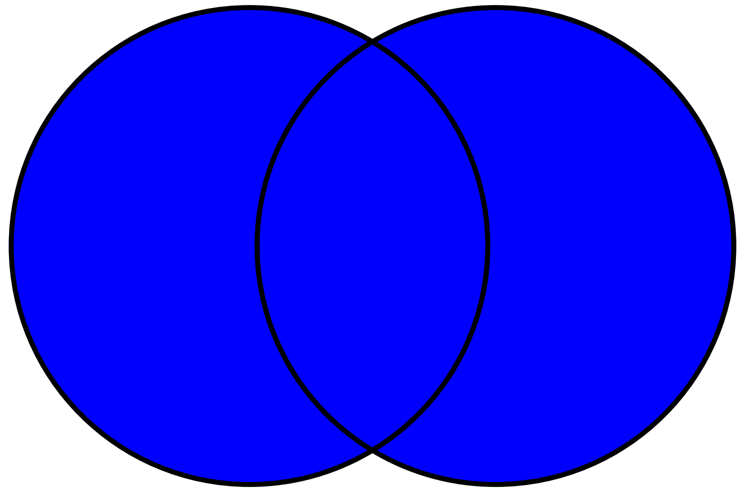
```
SELECT <fields>
FROM TableA  A
LEFT JOIN TableB  B
ON A.key = B.key
```



```
SELECT <fields>
FROM TableA  A
RIGHT JOIN TableB  B
ON A.key = B.key
```

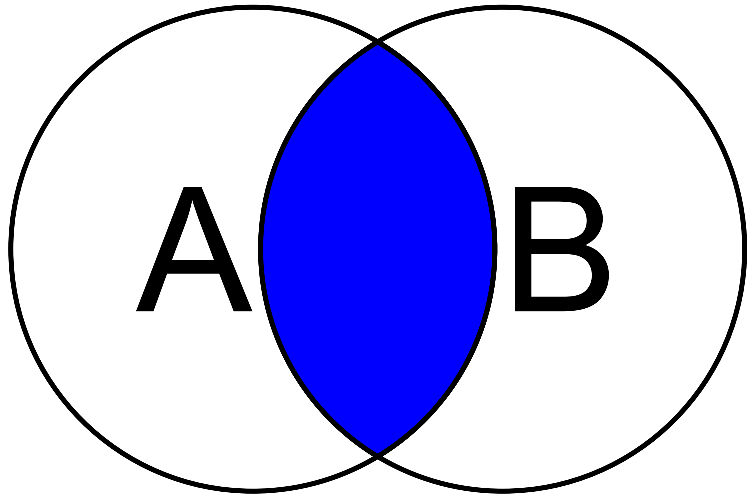


Inner/Outer Join

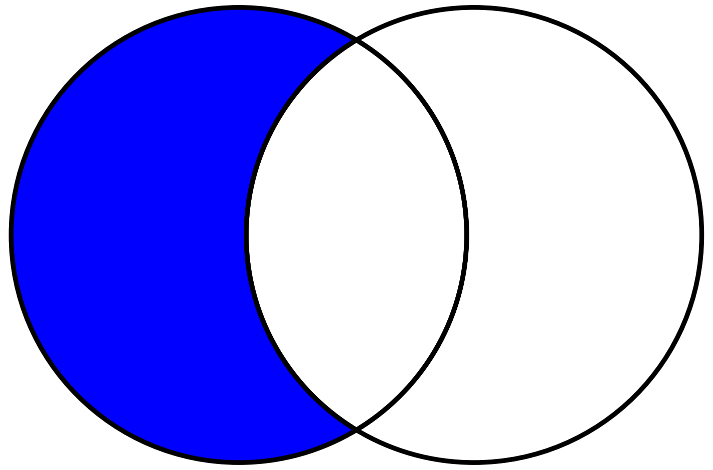


```
SELECT <fields>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.key = B.key
```

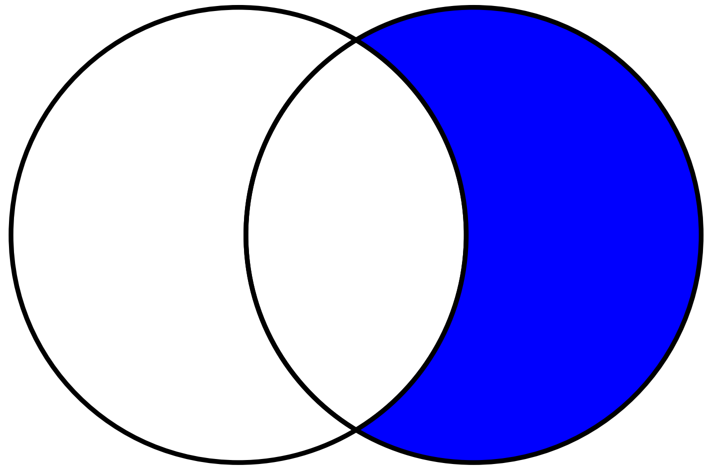
```
SELECT <fields>
FROM TableA A
INNER JOIN TableB B
ON A.key = B.key
```



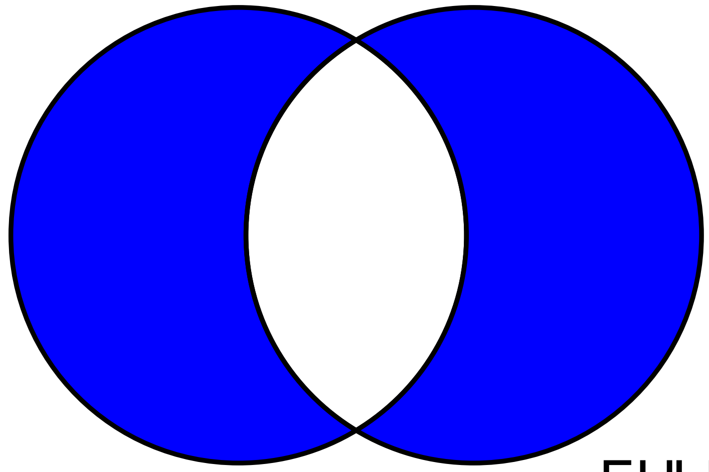
Anti-Joins



```
SELECT <fields>
FROM TableA A
LEFT JOIN TableB B
ON A.key = B.key
WHERE B.key IS NULL
```



```
SELECT <fields>
FROM TableA A
RIGHT JOIN TableB B
ON A.key = B.key
WHERE A.key IS NULL
```



```
SELECT <fields>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.key = B.key
WHERE A.key IS NULL
OR B.key IS NULL
```

EXERCISE

- Open DBeaver and connect to the Data Warehouse
  - From your Max Site AQI Query add the Latitude and Longitude of the site from the SourceSite table
    - Hint 1: JOIN statements go after the FROM statement
    - Hint 2: Adding Table Aliases tells the SQL Server which table you are selecting from

SOLUTION

```
SELECT MAX(Max.IndexValue) MaxAqi,
       Max.SiteName,
       Max.ParameterName,
       Site.Latitude,
       Site.Longitude
FROM Master.Health_AVData_AmbAqiSiteHistory Max

LEFT JOIN Master.Health_AVData_SourceSite Site
       ON Max.SiteName = Site.SiteName

GROUP BY Max.SiteName,
       Max.ParameterName,
       Site.Latitude,
       Site.Longitude
```

Writing SQL

SQL IDE'S

- There are a bunch of SQL IDE's each database provider has their own
- If you're in a workplace like mine with no standard then I suggest something like DBeaver because it connects to pretty much everything
- If not, then use whatever comes standard with the platform

DB Connections

CONNECTING

- Database connectors require that your computer has the necessary software.
  - This will depend on what database type you are trying to connect to

ALLOWING HANDSHAKES

- To setup database connections you will need to install the proper drivers.
  - The steps for this can be found here: https://db.rstudio.com/best-practices/drivers/
  - In general setup on Windows is a little bit easier since ODBC Data Source Administrator can be used
- Your machine may already have drives installed if you’ve already installed SQL IDE’s such as: pgAdmin, DBeaver, or the MySQL Workbench

Storing Credentials

ENVIRONMENTAL VARIABLE OR FILE

- You should never “hard code” your credentials into an app.

- Instead you should store them as environmental variables, or in a hidden file that you ignore in the Git Repository

  - Why?

If something requires that you to login, we can assume that not just anybody should be able to access it.
Think of your credentials like your debit card and pin number

BUILDING AN ENVIRON FILE

- The usethis package has a function that will build your .Renviron file in your directory or for your entire profile.

```
usethis::edit_r_environ("project")
```

- How are .Renviron Files structured?

```
uid=some_username
pwd=aPassword
```

A new line for each variable

No spaces between variable name and value

LOADING VARIABLES

- Small difference between credentials in your profile or the project folder.
- The string argument is the name you gave your variable

Profile

```
uid <- Sys.getenv("uid")
pwd <- Sys.getenv("pwd")
```

.Renviron

```
readRenviron(".Renviron")

uid <- Sys.getenv("uid")
pwd <- Sys.getenv("pwd")
```

ESTABLISHING CONNECTIONS

- Each data base type has a different connection string and list of requirements.

```
conn <- dbConnect(odbc::odbc(), driver = "FreeTDS", server ="IP_or_HOST_ADDRESS", port
    = 1433, database = "DBName", uid = un, pwd=pw, TDS_Version = "8.0")
```

- More on connection strings: https://db.rstudio.com/best-practices/drivers/#connecting-to-a-database-in-r

Your
Turn

Go to Rstudio and open the dbi_example.Rmd