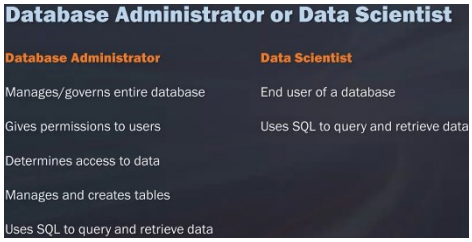
SQL

Fetch data and process it to derive valuable insights for decision making in organization

Week 1

DB admin and Data scientist

- Compare and contrast roles of DB admin and Data scientist
- Data scientist primarily use SQL for data retrieval, Combine and create tables, write queries for analysis and build test models



SQL

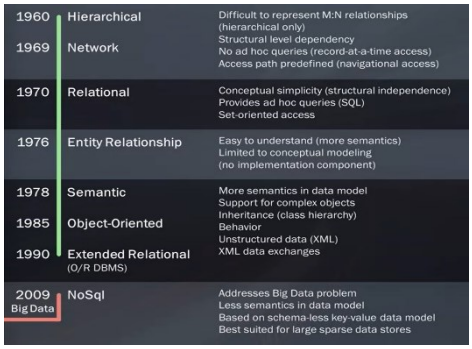
- SQL – Insert Query Update Modify [**C**reate **R**ead **U**pdate **D**elete : operations of database]
- Non procedural [cannot write applications]
- Descriptive statements to interact with database
- DBMS have dialect – SQL can translate

Data models

- Think about problem to solve before writing query
- Understand business process for which data is modeled, organized and structured
- Speeds up coding, less rework, improve accuracy
- RDB enables to write queries against structured data where relations between all tables are clearly defined

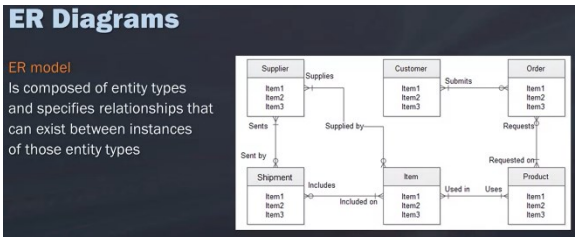
Types of models

- Relational model: Scalable and Structured [modeled] data for manipulation, analysis and logical querying using keys
- Transactional model: Operational data for transactions

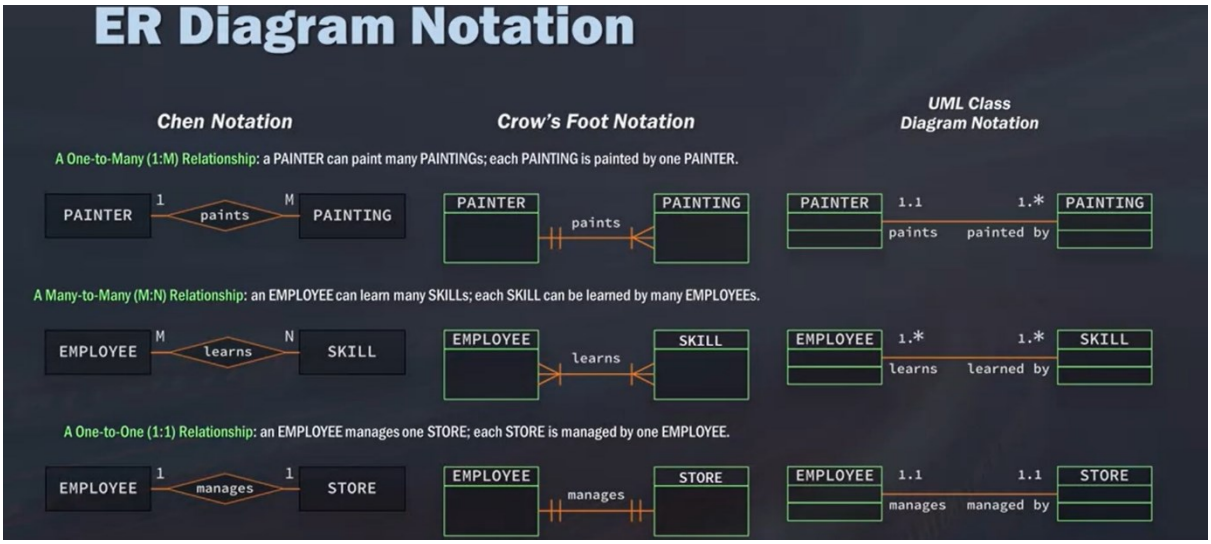


Modeling

- Show relationships[one to many, many to many]
- Show links[Primary – uniquely ID rows & foreign keys – group of columns to ID rows]



Notations in ER diagram



Reading material

- What is SQL and How is it Used?
- NTC Hosting: Structured Query Language (it's worth exploring this site, not just this singular posting)
- SQLite Tutorial
- Norwalk Aberdeen: Entity-Relationship Diagrams (9 Minute YouTube Video)
- Star Schema vs. Snowflake Schema
- Explain Star Schema & Snow Flake Design (5 Minute YouTube Video)
- Data Modeling 101
- What is Data Modeling - An Introduction for Business Analysts
- Wikipedia: Data Modeling
- Dataconomy: SQL vs. NoSQL - What You Need to Know
- TechRepublic: NoSQL keeps rising, but relational databases still dominate big data
- SiliconRepublic: Data Science Skills: Is NoSQL Better than SQL?

Week 2

SQL Statements

- **NULL : absence of everything**
- **Empty string : 0, spaces are present**
- **Comments :** block comment /* */, Line comment - -

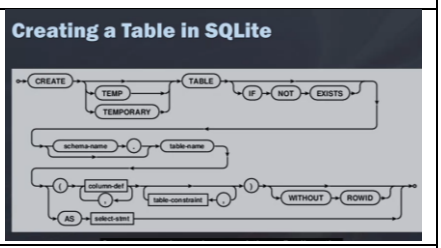
Wildcard % _

- Used with LIKE for string parsing, Does not accept NULL
- All wildcards do not work with all DBs eg : _ DB2, [] sqlite
- Helpful but reduces query performance; use operators as much as possible
- Add % sign in "optional" positions
- %pizza → ending with pizza
- %pizza% → has pizza as part of string
- %@%.com → match any email id
- Pi_ _ a → any 2 letters accepted between Pi and a

Arithmetic operations () ^ / * + -
SELECT a, (b-c)*d as e FROM table1

Typical precedence

- **SELECT** <column>
- **FROM** <table>
- **WHERE** <row level filter>
- **GROUP BY** <group by column>
- **HAVING** <condition on groups>
- **ORDER BY** <column with order>

Statement	Syntax	Description
CRUD operations		
SELECT – FROM	SELECT <columns> FROM <table> LIMIT <first N records>	
CREATE TABLE	CREATE TABLE < table > (<col1> CHAR(10) PRIMARY KEY <col2> INT(10) NOT NULL . .)	
CREATE TEMPORARY TABLE	CREATE TEMPORARY TABLE <temp_table> (SELECT * FROM <table> WHERE <col1> = [match value])	Create fast temporary table, deleted after session terminated simplify queries by creating a subset, and then joining to that subset, and derive a new calculation.
INSERT INTO	INSERT INTO < table >(<col1>, <col2>, …) VALUES('val1', 'Val2', …)	

VIEW	CREATE VIEW <viewname> [IF NOT EXISTS] AS SELECT <col1>,<col2> ... FROM <table> WHERE <condition>;	Store part of data in memory for time being
UPDATE	UPDATE table <table> SET <col1>= value1, <col2>= value2, ... WHERE condition;	
DELETE	DELETE FROM <table> WHERE condition;	
FILTER operations : DB are optimized for filtering Reduced amount of Specific[queried] data is pulled from database Increased query performance and reduced load at client side		
WHERE	SELECT <columns> FROM <table> WHERE <col1> <operator> <match value>	**Filter on rows** Operators =, <>, >, <, >=, <= IS NULL
BETWEEN	SELECT <columns> FROM <table> WHERE <col1> BETWEEN <val1> AND <val2>	BETWEEN <LL Val> AND <UL Val >
IN	SELECT <columns> FROM <table> WHERE <col1> IN (val1, val2,val3…)	IN (tuple of values and strings) In is faster than OR Sorted conditions are NOT required Can include subqueries inside val
OR	SELECT <columns> FROM <table> WHERE <col1> <operator> < value1> OR < value2> OR…	Order of operation is important
AND	SELECT <columns> FROM <table> WHERE <col1> <operator> < value1> AND < value2> AND…	Use parenthesis around OR statement preceding AND to avoid “short circuiting”
NOT	SELECT <columns> FROM <table> WHERE <col1> <operator> < value1> AND NOT < value2> AND…	Used to exclude a specific condition
LIKE	SELECT <columns> FROM <table> WHERE <col1> LIKE “%abc%”	Wildcard for string parsing
ORDER BY	SELECT <columns> FROM <table> ORDER BY <col1>, <col2>… [ASC|DESC]	Last clause on select statement Can use a table column which is not SELECT as part of output Can use column numbers **ASC|DESC** works only on immediate preceding column
Aggregate functions		
AVG	SELECT AVG(<column>) AS <avgCol> FROM <table>	Ignore NULL while calculating AVG
COUNT	SELECT COUNT(<column>) AS <countCol> FROM <table>	COUNT (*) Counts all rows in FROM clause **including NULL** if any COUNT (column) Counts all rows in FROM clause **ignoring NULL** if any
MIN	SELECT MIN(<column>) AS <minCol> FROM <table>	Locate outliers Ignore NULL while calculating MIN
MAX	SELECT MAX(<column>) AS <maxCol> FROM <table>	Locate outliers Ignore NULL while calculating MAX
SUM	SELECT SUM(<column>) AS <sumCol> FROM <table>	Ignore NULL while calculating SUM
GROUP BY	SELECT <columns> FROM <table> GROUP BY <col1>, <col2>..	Can use a table column only in SELECT clause [except calculated aggregation] Null are grouped together if present Use of ORDER BY is recommended

HAVING	SELECT <columns> FROM <table> GROUP BY <col1>, <col2>.. HAVING COUNT(*) <operator> <match value>	**GROUP BY – HAVING for group wise filtering**
Distinct function		
DISTINCT	SELECT COUNT(DISTINCT <column>) AS <countDistCol> FROM <table>	Without Distinct, SQL considers all data And ignore duplicates

Reading material

SQL for R

- SQLDF Package
- Documentation
- Examples

SQL for Spark

- Overview
- Documentation

SQL with Hadoop

- Hive Overview
- Documentation

SQL for Python

- Python-SQL Package Documentation

Week 3

Subqueries [SELECT FROM WHERE IN (SELECT FROM …)]

- **Definition:** Query inside other query with additional filtering criteria; Work on single and multiple tables

  E.g. Know region of each customer who had order with freight more than 100

  ```
  SELECT CustomerID, Region FROM Customers
  WHERE CustomerID in (
          SELECT CustomerID FROM Orders
          WHERE Freight > 100
          );
  ```

- **Calculated fields**

  E.g. Total order placed by every Customer

  ```
  SELECT Customer_name, States,
  (
      SELECT COUNT(*) AS Orders  FROM Orders
      WHERE Orders.CustomerID = Customers.CustomerID
  )
   FROM Customers
  ORDER BY Customer_name;
  ```

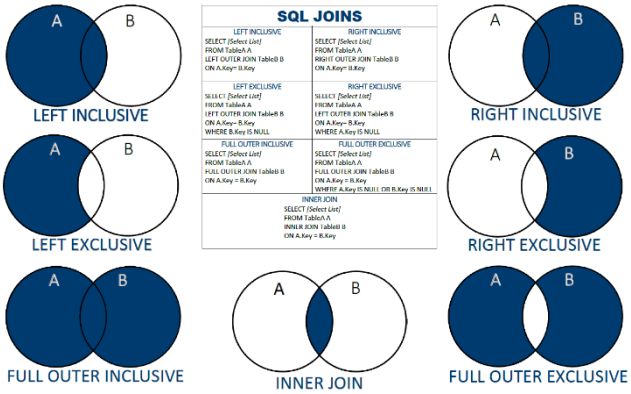
- **Limitations:** Deeply nested subqueries reduce query performance; Subquery Selects only one column at a time

Key Fields

- Data Segmentation i.e. Breaking data into tables logically models Business problem
- It makes data Scalable, easier for manipulation and analysis, makes storage efficient
- Logical querying using Keys which indicate attributes through which tables are related

Joins

- Instead of duplicating tables; tabled can be **joined** using keys – a nonphysical single line query
- Associate related records from different tables on the fly



Cross join : It is Cartesian Join each row from T1 with each row of T2

- computationally taxing because if you have a table with just ten records in it and the second table with ten records, just performing a Cross Join is already going to increase it to 100.

Inner Join: matching value from both table [INTERSECTION]

- Computationally taxing to find ON conditions

Left Join: Values from left table with matching value from right table

right Join: Values from right table with matching value from left table

Full outer Join: Return all records where there is a match in *either* table one *or* there's a match in table two

Union : Combine results from multiple SELECT statements by **stacking results**
All SELECT columns must be in same sequence and have same data types

Aliases: table names short formed for better access
E.g. SELECT O.order_ID FROM orders O;
Pre-qualifiers : subqueries for nested joins
E.g. SELECT P.product_name, O.unit_price, S.company
FROM (
    (suppliers S INNER JOIN products P ON S.supplierID = P.supplierID)
    INNER JOIN orders O ON P.productID = O.productID) ;

Reading material

- Thinking in SQL vs Thinking in Python
- Difference Between Union and Union All - Optimal Performance Comparison

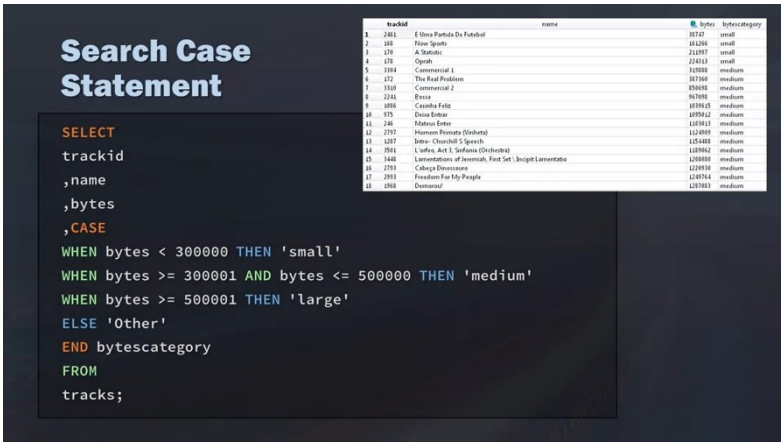
Week4

Concatenating : Link columns together **-** Use pipes
E.g. SELECT firstname, surname, firstname || surname FROM employees → firstname, surname, firstnamesurname
Trimming : TRIM everything from front and back OR RTRIM, LTRIM
E.g. SELECT TRIM (“ abc hdh “) AS trimmedString; → “abc hdh”
Substring function : select part of string - SUBSTR(<STRING>, A, B) gives substring starting at Ath character and return B subsequent characters
E.g. SELECT name, SUBSTR(“Jonathan”, 2,3) FROM employees → ona
Change Case - UPPER, LOWER, UCASE, LCASE
E.g. SELECT UPPER “myname” FROM employees → MYNAME
Datetime function : Different databases support different datatype : DATE, TIME, DATETIME, JULIANDAY, STRFTIME
STRFTIME : extract certain elements of a date/time string
E.g.

- SELECT birthdate, STRFTIME(“%y”, birthdate) AS birthyear from birthdays
- SELECT DATE(‘now’) → return present system date
- SELECT birthdate, DATE((“now”) - birthdate) AS Present_Age from birthdays → find current age from birth date

Time strings are extracted from DATETIME object

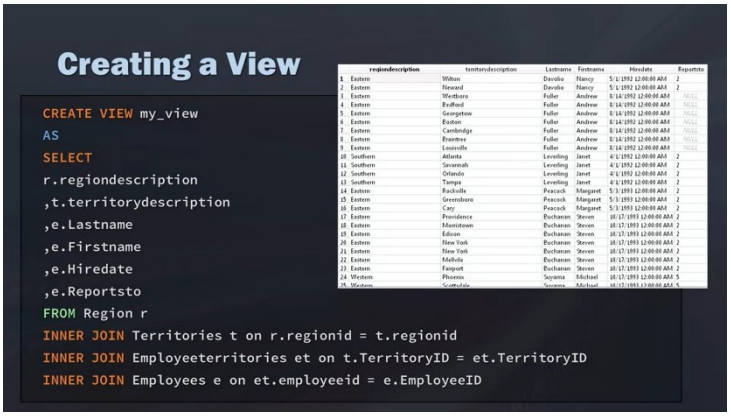
Case statements : Used inside SELECT, INSERT, DELETE, UPDATE to Categorize or Bin data
CASE WHEN THEN ELSE → IF THEN ELSE



Views

- A view is a stored query – an illusion of table
- Add remove columns without changing schema and database write limitations
- Tryout and encapsulate complex queries without ETL

SELECT * FROM <myView>
DROP VIEW <myView>



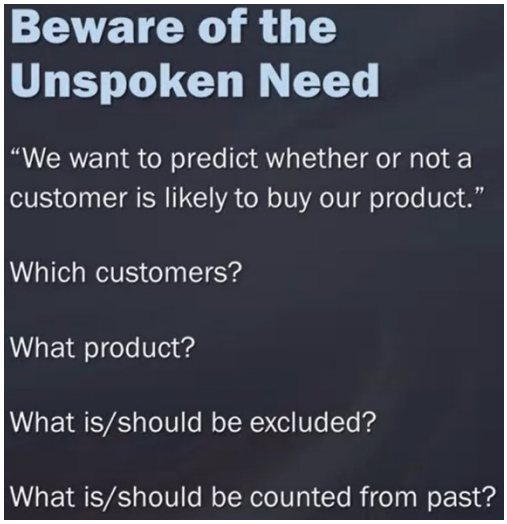
Data Governance and Profiling
Application of SQL in Data Science
Data Governance: looking at either descriptive statistics [columns MIN, MAX, DISTINCT, NULL, AVG] or different information on the data Rows [table size, last updated]
Profiling : Read and write policies about data site, clean up environment, escalation process

Data understanding ←→ Business understanding

- Unspoken requirements → requirement gathering

While profiling data:

- Details in data, create data model
  - draw out the different tables on a piece, of paper, basically creating my own data model and map.
- Consider joins and calculations necessary
- Data quality and format issues
- Test after each JOIN regressively
  - testing block by block allows you to find where any problems or issues occur
- Business rules – Date changes and Indicators
  - Has the data changed? Are the business rules different? Do you need to update and change the data indicators? Does anything need to be updated?



Reading material

- SQL Authority: SQL Puzzles
- SQLZOO