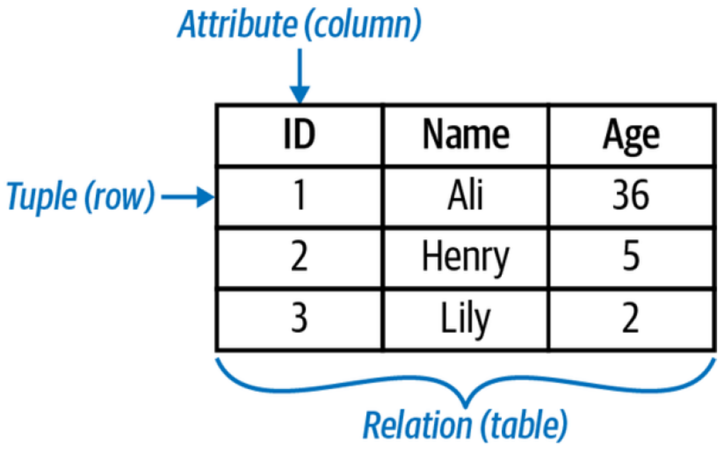
SQL Notes

SQL is a structured query language that involves using relational databases, which requires pre-defined schemas.



ID	Name	Age
1	Ali	36
2	Henry	5
3	Lily	2

CRUD Operations are most used in SQL. (Create, Read, Update, Delete)

SQL statements are divided into 4 main categories:

1. Data Definition Language (DDL)
   - CREATE (Create new database/table)
   - ALTER (Modify database/table structure)
   - DROP (Delete database or table)
   - TRUNCATE (Remove table records)

2. Data Manipulation Language (DML)
   - SELECT (Retrieve data from table)
   - INSERT (Insert new records into table)
   - UPDATE (Update existing records from a table)
   - DELETE (Remove existing records from a table)

3. Data Control Language (DCL)
   - GRANT (Assign privilege to users for accessing data)
   - REVOKE (Remove privilege to users for accessing data)

4. Transaction Control Statement (TCS)
   - COMMIT (Permanent work save into database)
   - ROLLBACK (Restore database to previous form since last commit)
   - SAVEPOINT (Create save point for future rollbacks)
   - SET TRANSACTION (Setting transaction to read-write/read only access)

SQL Query Basic Template

SELECT <column_names>

FROM <table_name>

WHERE <condition on columns from table>

GROUP BY <column_names>

HAVING <condition on grouped-by columns>

ORDER BY <column_names>

SQL works in the following order of statement execution:

1. Gathers all data with FROM clause
2. Filters the data with WHERE clause
3. Groups rows together with GROUP BY clause
4. Filters grouped rows with HAVING clause
5. Specifies columns to display with SELECT clause
6. Sorts the results with ORDER BY clause

Types of RDBMS and its database tools:

1. SQLite: DB Browser for SQLite
2. MySQL: MySQL Workbench
3. Oracle: Oracle SQL Developer (PL/SQL – Procedural Language Extension to SQL)
4. PostgreSQL: pgAdmin
5. SQL Server: SQL Server Management Studio (T-SQL – Transact SQL)

ANSI (American National Standards Institute) standard in SQL refers to SQL code that will run in any RDBMS software.

Identifiers vs Aliases

Identifiers are name of database objects

Aliases rename column or table temporarily, mostly useful in subqueries.

Statements vs Clauses

Statements are blocks of code that starts with a SQL keyword like SELECT and ends with a semicolon.

Clauses are specific sections of the statement that refers to specific SQL keywords like WHERE, FROM etc.

Single vs Multi-Line Comments

Single Line Comment:

-- This is a single line comment

Multi Line Comment:

/* These are

multi line comments */

Single vs Double Quotes

Single quote: Used for string reference

Double quote: Used for identifier reference

Wildcard expressions

%: Represents any n number of characters

_: Represents any single character

Note that these wildcard expressions are used together with LIKE or NOT LIKE keyword in WHERE clause.

SQL Data Types

1. Numeric (INT, DECIMAL, FLOAT)
   - INT: Used for values that do not allow for decimals (i.e. 45)
   - DECIMAL: Used for fixing number of decimals (i.e. 24.524)
   - FLOAT: Store limited number of decimals with power notation (i.e. 2.4524 * 10^5)

   Note: MySQL has the option of setting numeric variables as positive only using UNSIGNED keyword.

2. String (CHAR, VARCHAR, TEXT, NCHAR, NVARCHAR)
   - CHAR: Stores fixed length of characters as ASCII data
   - VARCHAR: Stores maximum length of specified characters as ASCII data
   - TEXT: Used for storing long strings of text like paragraphs
   - NCHAR: Stores fixed length of characters as Unicode data
   - NVARCHAR: Stores maximum length of specified characters as Unicode data

   Note: Unicode data refers to non-ASCII characters (non-English mostly)

3. Date (DATE, TIME, DATETIME, TIMESTAMP, YEAR – For MYSQL)
   - DATE: YYYY-MM-DD
   - DATETIME: YYYY-MM-DD hh:mm:ss
   - TIMESTAMP: YYYY-MM-DD hh:mm:ss UTC
   - TIME: hh:mm:ss
   - YEAR: YYYY

   Note: DATETIME variable type does not store time zone, while TIMESTAMP variable type does store time zone.

4. Boolean (BOOLEAN): FALSE value as 0 and TRUE value as 1
   Note: Boolean variable type is currently not supported in Oracle and SQL server.

5. External files like images, documents etc.
   Approach 1: Store links to files using VARCHAR variable type
   Approach 2: Convert files to binary format and store files using BLOB variable type

Common SQL Operators

Logical Operators

AND: Returns TRUE if both conditions are true or otherwise

OR: Returns TRUE if either condition is true or otherwise

NOT: Returns TRUE if condition is FALSE or otherwise

Comparison Operators (Used in conditional statements)

=	Equality	<=	Less than or equal to
!=, <>	Inequality	>	Greater than
<	Less than	>=	Greater than or equal to

Comparison Keywords (Used in conditional statements)

BETWEEN: Checks if value lies within given range (inclusive)

EXISTS: Checks if row exist in subquery (also known as semi-join)

IN: Checks if value is contained within a list using brackets symbol '( )' (Note that having a single null value within the list will always result in FALSE for conditional statements. Thus, recommend using **NOT EXISTS** keyword instead.)

IS NULL: Checks if a value is null

IS NOT NULL: Checks if a value is not null

LIKE: Checks if value matches a simple pattern (Used with wildcard expressions)

ALL: Returns TRUE if all subquery values meet specified condition (Requires comparison operator)

ANY: Returns TRUE if any subquery values meet specified condition (Requires comparison operator)

Note that "**= ANY**" can be represented by IN keyword and "**!= ANY**" can be represented by NOT IN keyword.

Math Operators

+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Modulo (Remainder)

Bitwise Operators

&: Bitwise AND

|: Bitwise OR

^: Bitwise XOR

Aggregate Functions

Aggregate functions perform calculations on multiple rows to return a single result.

Aggregate functions are mostly used in SELECT and HAVING clause

COUNT(): Counts number of values for a given attribute

SUM(): Sum of values for a given attribute

AVG(): Average of values for a given attribute

MIN(): Minimum value for a given attribute

MAX(): Maximum value for a given attribute

LEAST(): Minimum value from set of attributes for every row

GREATEST(): Maximum value from set of attributes for every row

Note that most of these aggregate functions in SQL applies to only non-null values, except for COUNT() function that applies to both null and non-null values.

Numeric Functions

Numeric functions are usually applied to attributes with numerical values only.

ABS(x)	Returns absolute value of x	**LOG10(x)**	Returns log of x base 10
SIGN(x)	Returns sign of value of x (-1 for negative, 0 for zero or 1 for positive)	**MOD(x,y)**	Returns remainder of x/y
POWER(x,y)	Returns x to the power of y	**RAND()**	Returns a random number between 0 and 1
SQRT(x)	Returns square root of x	**CEIL(x)**	Returns upper integer boundary of value x
EXP(x)	Returns exponent of x	**FLOOR(x)**	Returns lower integer boundary of value x
LOG(y,x)	Returns log of y base x	**ROUND(x,n)**	Rounds x value to n decimal places
LN(x)	Return natural log of x base e	**TRUNC(x,n)**	Cuts off x value at n decimal places without rounding

String Functions

String functions are usually applied to attributes with string data types.

LENGTH(string): Returns number of characters of a string

UPPER(string): Returns upper case characters of the whole string

LOWER(string): Returns lower case characters of the whole string

TRIM(string): Removes trailing and leading whitespaces from string

TRIM(char FROM string): Removes trailing and leading specified char from string

LTRIM(string): Removes leading whitespaces from string

RTRIM(string): Removes trailing whitespaces from string

CONCAT(string1, string2, …): Concatenate multiple strings into a single string

SUBSTRING(string, start, length): Returns a portion of string starting from start index for n length.

REPLACE(string, old_substring, new_substring): Replace old_substring from a given string with new_substring.

REGEXP ‘Regular_Expression’: Search for regular expression pattern

Finding index location of string syntax differs based on the software used.

INSTR(string, substring) : MySQL

CHARINDEX(substring, string, position) : SQL Server

POSITION(substring IN string) : PostgreSQL

Note: Regular expression syntax is best tested with the following website, instead of memorizing syntax: https://regex101.com/

<u>Regular Expressions in SQL</u>

*	Zero or more instances of previous element	[…]	Any character within brackets
+	One or more instances of previous element	[^…]	Any character not within brackets
.	Any single character	{n}	N instance of previous element
?	Zero or one instance of previous element	{n,}	At least N instance of previous element
^	Beginning of string	{n,p}	N to p instance of previous element
$	End of string	p1 | p2	Matches any patterns p1, p2, …

These quantifiers are usually used together with REGEXP keyword.

<u>Datetime Format Specifiers</u>

%Y	4-digit year	%d	Day (1-31)
%y	2-digit year	%h	12 hours (1 – 12)
%m	Numeric month (1-12)	%H	24 hours (1 – 24)
%b	Abbreviated month (Jan – Dec)	%i	Minutes (0-59)
%M	Name of month (January – December)	%s	Seconds (0-59)

Note that datetime functions for different SQL engines have different syntax used. Thus, it is recommended to google it rather than memorizing syntax.

<u>Null Functions</u>

Null functions are triggered when there is a missing value from attributes and an alternative output is provided as part of the function.

COALESCE(attribute, alternative): Returns “alternative” if null value exist in attribute

SELECT clause

1. Select specified columns
   SELECT cl1, cl2, … FROM table1

2. Select all columns
   SELECT * FROM table1

3. Select expressions
   SELECT UPPER(cl1), ROUND(cl1,2) FROM table1

4. Select qualifying columns from multiple tables
   SELECT table1.cl1, table2.cl2 FROM table1
   INNER JOIN table2 ON table1.cl3 = table2.cl3

5. Select subqueries
   SELECT cl1, (SELECT COUNT(*) FROM table2 WHERE table1.cl2 = table2.cl2) AS count_name
   FROM table1

6. Select all distinct values from columns
   SELECT DISTINCT cl1, cl2, … FROM table1

7. Select number of distinct values from columns
   SELECT COUNT(DISTINCT cl1, cl2, …) FROM table1

   Note that selecting number of distinct values from multiple columns is currently supported in MySQL and PostgreSQL.

FROM clause

1. Retrieve data from single table
   SELECT * FROM table1

2. Retrieve data from multiple tables
   SELECT a.*, b.* FROM table1 a
   INNER JOIN table2 b ON a.cl1 = b.cl1

3. Retrieve data from table derived from subquery
   SELECT cl1, total
   FROM
   (SELECT cl1, cl2, COUNT(*) AS total FROM table2 GROUP BY cl1, cl2 HAVING COUNT(*)>5) A

WHERE clause

1. Filters table based on single predicate (conditional statement)
   SELECT * FROM table1 WHERE condition1

2. Filters table based on multiple predicates
   SELECT * FROM table2 WHERE condition1 AND condition2

3. Filters table based on subquery
   SELECT cl1, cl2 FROM table1 WHERE cl3 IN (SELECT cl3 FROM table1 WHERE condition)

GROUP BY clause

GROUP BY keyword used for summarizing rows into various groups, where collection of rows is specified in GROUP BY clause and aggregation functions are used in SELECT clause.

SELECT cl1, cl2, SUM(cl3)

FROM table1

GROUP BY cl1, cl2

Note that all non-aggregated columns listed in SELECT clause must be included in GROUP BY clause and at least one aggregation function must be included in SELECT clause for query to work.

HAVING clause

HAVING keyword used for filtering rows based on aggregation functions only after GROUP BY clause is used.

SELECT cl1, cl2, SUM(cl3) as total

FROM table1

GROUP BY cl1, cl2

HAVING SUM(cl3) >5

Note that filtering rows based on non-aggregated columns must be used in WHERE clause and using aliases on HAVING clause will result in error due to order of SQL statement execution.

ORDER BY clause

ORDER BY keyword used for specifying order of results from query to be sorted.

Default sorting is in ascending order (ASC), unless specify DESC for descending order.

SELECT cl1, cl2, ROUND(cl4, 3) AS rounder FROM table1

ORDER BY cl3 ASC, cl2 DESC, rounder ASC

Columns with aliases, other columns and expressions not within the SELECT clause can be used for sorting since FROM clause is executed first and SELECT clause is executed before ORDER BY clause.

Note that ORDER BY clause cannot be used within a subquery.

Subqueries

Subqueries are queries nested inside another query, which can be found in various clauses like SELECT, FROM, WHERE or JOIN clause.

Subqueries must be surrounded by parenthesis () and including aliases except for subqueries in WHERE clause.

Subqueries are always executed from inner-most query to outer-most query.

Caveats to note for subqueries:

1. Using subqueries in SELECT clause requires result to return a single column and either zero or one row. If subquery returns one column and zero rows, the results will be filled with NULL values
2. Using subqueries in FROM clause requires the query to be independent without referring to values outside of the subquery.
3. Using subqueries in WHERE clause requires use of IN() or NOT IN() keywords if subquery returns multiple rows.

Advantages of subqueries in FROM clause:

1. Reduce problems to smaller steps required
2. Reduce table size in FROM clause to improve query performance

Advantages of subqueries in WHERE clause: Easier for code understanding

Correlated subqueries

Correlated subqueries are queries that refer to values obtained in outer queries.

Correlated subqueries execute once for every row from the outer query. Thus, correlated subqueries comes with read performance issues.

It is recommended to use other approaches like Joins or CTE (Common table expressions) when possible.

Limiting view of number of rows

Different syntax is used for this task depending on SQL software used.

For MySQL, PostgreSQL (Note that LIMIT clause is executed last after ORDER BY clause):

SELECT cl1, cl2

FROM owner

LIMIT n

For SQL Server:

SELECT TOP n cl1, cl2

FROM owner

For Oracle:

SELECT cl1, cl2

FROM owner

WHERE ROWNUM <= n

<u>Functions for summarizing rows into lists</u>

Using together with GROUP BY clause, the following functions can be used for summarizing multiple rows into list of values:

MYSQL	**GROUP_CONCAT (DISTINCT x SEPARATOR ‘,’ ORDER BY x)**
SQL Server	**STRING_AGG(x, ‘,’) WITHIN GROUP (ORDER BY x)**
PostgreSQL	**ARRAY_AGG(DISTINCT x ORDER BY x)**

Note the following caveats:

1. SQL server currently does not support “Unique” list
2. PostgreSQL only accepts ‘,’ as default separator
3. SQL server requires input of separator, while input of separator is optional for MYSQL

<u>Complex Group-By Functions</u>

Additional summary information can also be included in queries using the following complex group-by functions:

1. GROUP BY ROLLUP (a,b, ….,e)
   - Group by sets of a – e, a – d, …. a and ()

2. GROUP BY CUBE (a,b, …., e)
   - Group by all combination of sets and ()

3. GROUP BY GROUPING SETS(a,b,…,())
   - Group by individual categories and (), which represents group function on entire table

Note that these functions are mostly supported in Oracle, PostgreSQL and SQL server.

MySQL only supports rollup function using the following syntax:

GROUP BY a, b, …., e WITH ROLLUP

Window Functions

Window functions return value for each row of the dataset that relates to result from current query.

Window functions are mostly used in SELECT & ORDER BY clause and useful for combining non-aggregated columns and aggregated columns together without relying on GROUP BY clause.

Filtering columns related to window functions requires use of subqueries, because window functions are executed 2nd last prior to ORDER BY clause.

Basic syntax:

AGG_FUNC() OVER (PARTITION BY cl1 ORDER BY cl2)

Note that PARTITION BY clause has similar behavior as GROUP BY clause and basic aggregation functions can also be used in the syntax above.

By default, ORDER BY clause within OVER clause has "Cumulative function" behavior (hidden syntax is **RANGE BETWEEN UNBOUNDED PRECEDING AND CURRENT ROW**)

The behavior (sliding windows) of ORDER BY clause within OVER clause can be adjusted to the following:

1. Moving N previous records
   RANGE BETWEEN N PRECEDING AND CURRENT ROW

2. Moving N following records
   RANGE BETWEEN CURRENT ROW AND N FOLLOWING

3. Moving N previous and N following records
   RANGE BETWEEN N PRECEDING AND N FOLLOWING

Note that **RANGE BETWEEN** can be replaced by **ROW BETWEEN** instead.

RANGE BETWEEN will return same running value for each duplicated time, while ROW BETWEEN returns different running value for each row

List of window functions:

1. **ROW_NUMBER()** : Returns row number of every record without “ties”
2. **RANK()** : Returns rank of current row with “ties” allowed and “gaps” allowed
3. **DENSE_RANK()** : Returns rank of current row with “ties” allowed and “gaps” not allowed
4. **FIRST_VALUE(cl1)** : Returns value of cl1 at 1st row of window frame
5. **LAST_VALUE(cl1)** : Returns value of cl1 at last row of window frame
6. **NTH_VALUE(cl1, n)** : Returns value of cl1 at nth row of window frame
7. **LEAD(cl1, n)** : Returns value of cl1 at n rows after current row (Default n is 1)
8. **LAG(cl1, n)** : Returns value of cl1 at n rows before current row (Default n is 1)
9. **NTILE(n)** : Returns rank of current row by dividing partition into n-sections

Types of Joins

Joins can be used in SQL for combining multiple tables with similar characteristics.

SELECT *

FROM table1 AS A

INNER/LEFT/RIGHT JOIN table2 AS B

ON A.cl1 = B.cl1

Note that ON clause can be replaced with **USING(cl1)** if both tables are joined together using the same column name cl1

Cross Joins can also be used for returning all combination of rows in multiple tables.

SELECT *

FROM table1

CROSS JOIN table2

Self joins can also be used for comparing between rows in the same table.

SELECT *

FROM table1 a

INNER JOIN table1 b

ON a.cl1 = b.cl1 AND a.cl2 != b.cl2

Stacking Results of Multiple Queries

While joins can be used to link multiple tables based on common columns, UNION operator can be used to stack results of multiple queries.

(SELECT cl1, cl2 FROM table1

WHERE condition1)

UNION/UNION ALL

(SELECT cl1, cl2 FROM table2

WHERE condition2

ORDER BY cl1)

Note that UNION/UNION ALL operator requires the following conditions:

1. Same number of columns
2. Same order of columns
3. Similar data types between columns from multiple queries

UNION operator is used for selecting results that are distinct between queries, while UNION ALL operator is used for selecting all results including duplicates from multiple queries.

CASE statements

Case statements are similar to if-then-else statements.

```
CASE
        WHEN condition1 THEN result1
        WHEN condition2 THEN result2
        ELSE result3
END AS Alias_Name
```

Common Table Expressions

Common table expressions (CTE) are temporary results that can be used in other queries.

Two types of CTE:

1. Non-recursive CTE

```
WITH cte_name (cl1, cl2, …) AS (
Query1
)
SELECT cl1, cl2, …
FROM cte_name
```

2. Recursive CTE

```
WITH RECURSIVE cte_name (cl1, cl2, …) AS(
Query1       ┐
UNION        ├  Anchor members (Starting points)
Query2       ┘
UNION ALL
SELECT …         ┐
FROM cte_name    ├  Recursive member
WHERE condition  ┘  # Termination Check
)
SELECT cl1, cl2, …
FROM cte_name
```

Note that MySQL and PostgreSQL does not require RECURSIVE keyword, while SQL server requires RECURSIVE keyword.

Note that multiple CTE can be created within the same WITH clause.

```
WITH cte_name1(cl1, cl2, …) AS(query),
cte_name2(cl1, cl2, …) AS(query) …
```

Advantages of using CTE over Subqueries:

1. CTE name can be referenced multiple times in multiple queries
2. Multiple CTE names can be defined upfront before main query
3. CTE can be referenced within each other

However, older versions of SQL software do not support CTE. Thus, subqueries are still widely used.

Recursive CTE are mostly used in the following scenarios:

1. Filling in missing rows of sequence of data
2. Return all parents of a child row (hierarchical data structure)

Note the following caveats for CTE:

1. Number of columns defined in CTE must match number of columns defined within WITH clause
2. Same number of columns and data types in both anchor and recursive members of the CTE
3. FROM clause of recursive member refers only one time to cte_name
4. UNION used to stack multiple anchor members together
5. UNION ALL used to stack last anchor member with multiple recursive members together
6. Following keywords/functions not allowed in recursive members:
   - SELECT DISTINCT
   - GROUP BY
   - HAVING
   - ORDER BY
   - All joins (except for inner join)
   - Subqueries
   - Group functions (Aggregation and Window functions)

Data model/Schema

Data model/Schema describes how database objects are organized within a database

The following actions can be done with respect to databases:

1. Creating new database
   CREATE DATABASE db_name

2. Delete existing database
   DROP DATABASE db_name

3. Using database (MySQL and SQL Server)
   USE db_name

4. Display names of all existing databases
   SHOW databases (MySQL)

   SELECT name FROM master.sys.databases (SQL Server)

5. Display name of current database
   SELECT database() (MySQL)

   SELECT db_name() (SQL Server)

Creating/Modifying Tables

The following actions can be done with respect to tables:

1. Creating new tables
   ```
   CREATE TABLE IF NOT EXISTS tb_name(
           var1 dtype1,
           var2 dtype2,
           …
   )
   ```

2. Remove whole data inside table
   TRUNCATE TABLE tb_name

3. Remove whole table
   DROP TABLE IF EXISTS tb_name

4. Insert records into tables
   INSERT INTO tb_name (cl1, cl2, …)
   VALUES (cl1, cl2, …), (cl1, cl2, …)

5. Delete records from tables
   DELETE FROM tb_name
   WHERE condition

6. Update records from tables
   UPDATE tb_name
   SET cl1 = value1, …
   WHERE condition

7. Display names of existing tables
   SHOW tables (MySQL)

   SELECT tb_name FROM information_schema.tables (SQL Server)

8. Display columns of existing tables
   DESCRIBE tb_name (MySQL)

   SELECT cl1, cl2, …
   FROM information_schema.columns WHERE table_name = tb_name (SQL Server)

9. Adding new columns
   ALTER TABLE tb_name
   ADD cl_name dtype

10. Removing columns
    ALTER TABLE tb_name
    DROP COLUMN cl_name

11. Change data type of columns
    ALTER TABLE tb_name
    ALTER COLUMN cl_name dtype

<u>SQL Constraints</u>

Constraints are rules that specify what data can be inserted into a table.

Types of SQL Constraints:

1. NOT NULL: Restrict columns to not allow null values
2. DEFAULT: Setting default values that replaces missing values
3. CHECK: Filters inputs based on certain conditions
4. UNIQUE: Restrict columns to only allow unique values
5. PRIMARY KEY: Candidate key that uniquely identifies a row
6. FOREIGN KEY: Candidate key within one table that matches with candidate key in other tables.

Note that primary key must be created first, before creating foreign keys.

Example:

```
CREATE TABLE table1(
        id INTEGER PRIMARY KEY
)
CREATE TABLE table2(
        id INTEGER PRIMARY KEY,
        FOREIGN KEY id1 REFERENCES table1(id)
)
```

For creating table with auto-generated fields, following syntax is used:

cl_name dtype PRIMARY KEY AUTO_INCREMENT (MySQL)

cl_name dtype IDENTITY(1,1) (SQL Server)

The following actions can be done for constraints:

1. Create new constraints when creating tables
   CONSTRAINT ct_name ……

2. Create new constraints when altering tables
   ALTER TABLE tb_name
   ADD CONSTRAINT ct_name …….

3. Modify existing constraints when altering tables
   ALTER TABLE tb_name
   ALTER COLUMN cl_name dtype new_ct

4. Remove existing constraint
   ALTER TABLE tb_name
   DROP CONSTRAINT ct_name

5. Display table constraints
   For MySQL:
   SHOW CREATE TABLE tb_name

   For non-default constraints in SQL Server:
   SELECT table_name, constraint_name, constraint_type
   FROM information_schema.table_constraints
   WHERE table_name = 'tb_name’

   For default constraints in SQL Server:
   SELECT OBJECT_NAME(parent_object_id),
   COL_NAME(parent_object_id, parent_column_id), definition
   FROM sys.default_constraints
   WHERE OBJECT_NAME(parent_object_id) = 'tb_name’

Indexes

Indexes are useful for retrieving data from very large datasets more quickly that speeds up SELECT and WHERE queries.

However, index is not useful under following scenarios:

1. Columns with frequent, large batch updates on insert operations
2. Columns with large number of null values
3. Tables with small number of records
4. Columns that are frequently manipulated

The following actions can be done for indexes:

1. Creating new index
   CREATE INDEX index_name
   ON tb_name (cl1, cl2, …)

2. Remove existing index
   DROP INDEX index_name ON tb_name

Views

Views can be created for the following benefits:

1. Restrict users from accessing sensitive information on the original database
2. Hide and reuse complex queries
3. Provide more meaningful aliases to variables in the original database

There are two types of views in SQL:

1. Inline views: Temporary results from subqueries used in FROM clause
2. Views: Referenced virtual tables from result of query that does not take up additional storage space and can be reused

The following actions can be done for views:

1. Create new views/replace existing views
   CREATE VIEW vw_name AS
   Query

2. Remove existing views
   DROP VIEW vw_name

3. Display existing views
   For MySQL:
   SHOW FULL_TABLES WHERE table_type = ‘VIEW’
   For SQL Server:
   SELECT table_name FROM information_schema.views

Note that data cannot be inserted or removed from views once created.

Transactions

Transaction allows for safer updates on database through a sequence of SQL operations as a single unit.

Using the concept of atomicity, either all SQL operations are executed or not under a transaction.

Transaction Keywords in SQL:

1. **START TRANSACTION / BEGIN TRANSACTION**: Used to initiate a new transaction (Start transaction keyword used for MySQL and PostgreSQL, while Begin transaction keyword used for SQL Server)

2. **SAVEPOINT point_name**: Used to save state of transaction at specific points of the query code in which to rollback.

3. **RELEASE SAVEPOINT point_name**: Used to remove state of transaction saved.

4. **ROLLBACK TO point_name**: Rollback changes to before transaction occurs or back to a previous savepoint.

5. **COMMIT**: Make permanent changes to the database

Note that once a transaction is committed, it is no longer reversible.