1. String Functions

String functions manipulate or retrieve information about string data.

- Basic Operations:
  - ASCII(str) – Returns the ASCII value of the first character.
  - BIN(N) – Converts a number to binary.
  - CHAR(N,...) – Returns the character for each ASCII code.
  - CHAR_LENGTH(str) / LENGTH(str) – Returns the string length.
  - CONCAT(str1, str2,...) – Concatenates strings.
  - CONCAT_WS(separator, str1,...) – Concatenates with a separator.
  - FIELD(str, str1,...) – Returns the index of a string.
  - FIND_IN_SET(str, str_list) – Finds the index of a string in a list.
  - FORMAT(X, D) – Formats a number with commas and decimals.
  - INSERT(str, pos, len, new_str) – Replaces part of a string.
- Substrings and Searching:
  - LOCATE(substr, str, pos) – Finds the position of a substring.
  - POSITION(substr IN str) – Alias for LOCATE.
  - SUBSTRING(str, pos, len) / SUBSTR() – Extracts a substring.
  - LEFT(str, len) / RIGHT(str, len) – Extracts from left/right.
- Modification:
  - LOWER(str) / UPPER(str) – Changes case.
  - TRIM([remstr FROM] str) – Removes leading/trailing spaces.
  - REPLACE(str, from_str, to_str) – Replaces all instances.
  - REVERSE(str) – Reverses a string.
- Padding and Spaces:
  - RPAD(str, len, padstr) / LPAD() – Pads a string.
  - SPACE(N) – Returns a string of N spaces.
- Other:
  - HEX(str) / UNHEX() – Converts to/from hexadecimal.
  - QUOTE(str) – Escapes special characters.

  - ELT(N, str1,...) – Returns the N-th string.
  - MAKE_SET(bits, str1,...) – Returns a comma-separated list of strings.
  - EXPORT_SET(bits, on, off[, sep[, number_of_bits]]) – Converts bits to a string representation.

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2. Numeric Functions

Numeric functions perform mathematical calculations.

- Basic Arithmetic:
  - ABS(X) – Absolute value.
  - CEIL(X) / CEILING() – Rounds up.
  - FLOOR(X) – Rounds down.
  - ROUND(X, D) – Rounds to D decimals.
  - TRUNCATE(X, D) – Truncates to D decimals.
- Exponents and Roots:
  - EXP(X) – Exponential of X.
  - LOG(X) – Natural logarithm.
  - LOG10(X) – Base-10 logarithm.
  - POWER(X, Y) / POW() – X raised to the power Y.
  - SQRT(X) – Square root.
- Random Numbers:
  - RAND([seed]) – Random number.
  - PI() – Returns π.
- Sign and Comparison:
  - SIGN(X) – Returns -1, 0, or 1 based on sign.
  - GREATEST(X1, X2,...) – Returns the largest value.
  - LEAST(X1, X2,...) – Returns the smallest value.
- Trigonometry:
  - SIN(X) / COS(X) / TAN(X) – Trigonometric functions.
  - ASIN(X) / ACOS(X) / ATAN(X) – Inverse trigonometric functions.

    - DEGREES(X) / RADIANS(X) – Converts between degrees and radians.

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3. Date and Time Functions

Manipulate and retrieve date/time values.

- Current Date/Time:
    - NOW() / CURRENT_TIMESTAMP() – Current date and time.
    - CURDATE() / CURRENT_DATE() – Current date.
    - CURTIME() / CURRENT_TIME() – Current time.
    - UTC_TIMESTAMP() / UTC_DATE() / UTC_TIME() – UTC equivalents.
- Extracting Components:
    - YEAR(date) / MONTH() / DAY() – Extracts date parts.
    - HOUR(time) / MINUTE() / SECOND() – Extracts time parts.
    - DAYOFWEEK(date) – Returns the weekday (1=Sunday).
    - DAYOFYEAR(date) – Day of the year.
    - WEEK(date) / WEEKOFYEAR() – Week number.
- Date Arithmetic:
    - ADDDATE(date, interval) / SUBDATE() – Adds or subtracts intervals.
    - DATE_ADD(date, interval) / DATE_SUB() – Similar to above.
    - DATEDIFF(date1, date2) – Difference between two dates.
    - TIMESTAMPDIFF(unit, datetime1, datetime2) – Difference in specified units.
- Conversion and Formatting:
    - DATE_FORMAT(date, format) – Formats a date.
    - STR_TO_DATE(str, format) – Converts a string to a date.
    - UNIX_TIMESTAMP(date) – Converts date to timestamp.
    - FROM_UNIXTIME(ts) – Converts timestamp to date.
    - SEC_TO_TIME(seconds) / TIME_TO_SEC(time) – Converts between time and seconds.

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4. Aggregate Functions

Aggregate functions operate on groups of rows.

- AVG(column) – Average value.
- SUM(column) – Total value.
- COUNT(column) – Number of rows.
- MAX(column) / MIN(column) – Maximum and minimum values.
- GROUP_CONCAT(column) – Concatenates values.

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5. JSON Functions

Manipulate JSON data.

- JSON_OBJECT(key, value,...) – Creates a JSON object.
- JSON_ARRAY(value,...) – Creates a JSON array.
- JSON_EXTRACT(json, path) – Extracts data from JSON.
- JSON_SET(json, path, value) – Updates JSON.
- JSON_REMOVE(json, path) – Removes JSON elements.
- JSON_CONTAINS(json, value) – Checks if JSON contains a value.
- JSON_ARRAYAGG(column) – Aggregates column values into a JSON array.

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6. Control Flow Functions

Control the flow of query logic.

- IF(expr, true_value, false_value) – Conditional logic.
- CASE – Multi-condition branching.
- IFNULL(expr, value) – Returns value if expression is NULL.
- NULLIF(expr1, expr2) – Returns NULL if two values are equal.

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7. Window Functions (MySQL 8.0+)

Perform calculations over rows in a result set.

- ROW_NUMBER() – Sequential row number.
- RANK() – Rank of rows with gaps.
- DENSE_RANK() – Rank of rows without gaps.
- NTILE(N) – Divides rows into N buckets.

- LEAD() / LAG() – Access rows before/after current row.

10. Bitwise Functions

Operate on bits in numbers.

- BIT_COUNT(N) – Returns the number of bits set to 1 in the binary representation.
- BIT_AND(expr) – Performs bitwise AND for all rows.
- BIT_OR(expr) – Performs bitwise OR for all rows.
- BIT_XOR(expr) – Performs bitwise XOR for all rows.

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11. Spatial (GIS) Functions

MySQL supports spatial data types like GEOMETRY, POINT, LINESTRING, and provides functions to work with GIS data.

- **Geometry Constructors**:
    - ST_GEOMFROMTEXT(wkt) – Creates a geometry from Well-Known Text (WKT).
    - ST_POINT(x, y) – Creates a point geometry.
    - ST_POLYGONFROMTEXT(wkt) – Creates a polygon from WKT.
    - ST_LINESTRINGFROMTEXT(wkt) – Creates a line string from WKT.
- **Spatial Calculations**:
    - ST_DISTANCE(g1, g2) – Computes the minimum distance between two geometries.
    - ST_AREA(geometry) – Calculates the area of a polygon.
    - ST_LENGTH(geometry) – Calculates the length of a geometry.
    - ST_INTERSECTS(g1, g2) – Checks if two geometries intersect.
    - ST_CONTAINS(g1, g2) – Checks if one geometry contains another.
- **Spatial Metadata**:
    - ST_ASWKT(geometry) – Converts a geometry to WKT.
    - ST_ASGEOJSON(geometry) – Converts a geometry to GeoJSON.

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12. Privilege and Security Functions

Handle user authentication, privileges, and security.

- **Privilege Checks**:

    - HAS_ROLE(role_name) – Checks if the current user has a specific role.
    - IS_ROLE_ACTIVE(role_name) – Checks if a role is active.
- **SSL and Authentication**:
    - SSL_SESSION_ID() – Returns the current SSL session ID.
    - USER() – Returns the authenticated user.

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13. Performance Schema Functions

Retrieve performance metrics about server execution.

- **Query Profiling**:
    - FORMAT_BYTES(N) – Formats byte values as human-readable strings.
    - FORMAT_PICO_TIME(N) – Formats time in a human-readable format.
    - TIMER_WAIT() – Returns the time a thread waits.
- **Thread Functions**:
    - THREAD_ID() – Returns the ID of the current thread.
    - SLEEP(seconds) – Pauses the session for a specified time.

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14. Miscellaneous Functions

Some functions are specific to uncommon use cases or debugging.

- UUID() – Generates a globally unique identifier.
- UUID_SHORT() – Generates a short, unique identifier.
- NAME_CONST(name, value) – Returns a constant with the given name and value.
- BENCHMARK(count, expr) – Repeats an expression a specified number of times (used for testing performance).
- INET_ATON(ip) / INET_NTOA(num) – Converts IP addresses to/from numeric values.
- INET6_ATON(ip) / INET6_NTOA(num) – Converts IPv6 addresses to/from numeric values.
- IS_FREE_LOCK(lock_name) – Checks if a named lock is free.
- MASTER_POS_WAIT(log_name, log_pos[, timeout]) – Waits until the replication master reaches a certain position.

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15. Replication Functions

Used in master-slave or group replication configurations.

- GTID_SUBSET(gtid_set1, gtid_set2) – Checks if one GTID set is a subset of another.
- GTID_SUBTRACT(gtid_set1, gtid_set2) – Subtracts one GTID set from another.
- WAIT_FOR_EXECUTED_GTID_SET(gtid_set, timeout) – Waits until the given GTID set is executed.
- WAIT_UNTIL_SQL_THREAD_AFTER_GTIDS(gtid_set) – Waits for SQL thread to execute specific GTIDs.

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16. Debugging Functions

Help in debugging and testing queries.

- GET_LOCK(name, timeout) – Acquires a named lock.
- RELEASE_LOCK(name) – Releases a named lock.
- IS_USED_LOCK(name) – Checks if a named lock is in use.
- LAST_INSERT_ID() – Returns the last inserted auto-increment ID.

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17. Advanced JSON Functions

Expanding JSON functionality further:

- JSON_KEYS(json[, path]) – Returns the keys of a JSON object.
- JSON_LENGTH(json[, path]) – Returns the length of a JSON array or object.
- JSON_MERGE(json1, json2) – Merges JSON documents.
- JSON_UNQUOTE(json_path) – Unquotes a JSON string.
- JSON_PRETTY(json) – Formats JSON in a readable way.

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18. Regular Expression Functions (MySQL 8.0+)

Work with patterns in strings.

- REGEXP_LIKE(str, pattern) – Checks if a string matches a pattern.
- REGEXP_INSTR(str, pattern) – Returns the position of the first match.
- REGEXP_SUBSTR(str, pattern) – Extracts the substring that matches a pattern.

- REGEXP_REPLACE(str, pattern, replacement) – Replaces occurrences of a pattern.

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19. Window Functions (Analytical Functions) (MySQL 8.0+)

Perform calculations across a window of rows.

- CUME_DIST() – Cumulative distribution of a value.
- PERCENT_RANK() – Returns the percentile rank.
- NTH_VALUE(expr, N) – Returns the N-th value in a result set.