

# 1 Aggregate Functions

SQL offers five standard built-in aggregate functions:

- Average: **AVG**
- Minimum: **MIN**
- Maximum: **MAX**
- Total: **SUM**
- Count: **COUNT**

Few points regarding aggregate functions are as follows.

1. In general, NULL values are discarded when aggregate functions are applied to a particular column (attribute); the only exception is for **COUNT(\*)** because tuples instead of values are counted.
2. The general rule is as follows: when an aggregate function is applied to a collection of values, NULLs are removed from the collection before the calculation; if the collection becomes empty because all values are NULL, the aggregate function will return NULL (except in the case of **COUNT**, where it will return 0 for an empty collection of values).
3. The input to **SUM** and **AVG** must be a collection of numbers, but the other operators can operate on collections of nonnumeric data types, such as strings, as well.
4. The functions **MAX** and **MIN** can also be used with attributes that have non-numeric domains if the domain values have a *total ordering*<sup>1</sup> among one another.
5. **COUNT(\*)** returns the number of rows in the result of the query.
6. SQL does not allow the use of **DISTINCT** with **COUNT (\*)**. However, **ALL** can be used in place of **DISTINCT**.
  - Invalid: **SELECT COUNT(DISTINCT \*) FROM r**
  - Valid: **SELECT COUNT(ALL \*) FROM r**
7. It is legal to use **DISTINCT** with **MAX** and **MIN**, even though the result does not change.

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<sup>1</sup>Total order means that for any two values in the domain, it can be determined that one appears before the other in the defined order; for example, DATE, TIME, and TIMESTAMP domains have total orderings on their values, as do alphabetic strings