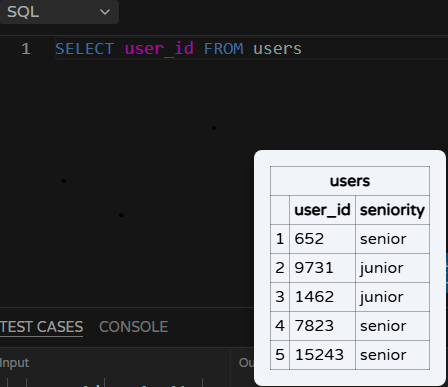
**Introduction**

**SQL** (Structured Query Language) is a standard language for managing and manipulating relational databases. It allows users to store, retrieve, and analyze data efficiently, making it essential for businesses and organizations worldwide. Example below:



**What is a Database?**

Databases are like large buckets that store data in an organized manner. A few examples of when we would like to create a database:

* A database for a university to save data about students, courses, and lecturers.
* A database for a car agency to track sales, car storage, and employees.
* And many more

Inside a database there are tables, and each table has a name, column names, and rows. For example, this is a **workers** table below:

Workers

|  | **firstName** | **lastName** | **age** | **exp\_years** | **gender** |
| --- | --- | --- | --- | --- | --- |
| 1 | Ghully | Thuas | 29 | 2.3 | Female |
| 2 | Bostal | Shkolky | 32 | 0.2 | Male |
| 3 | Qaostu | Malop | 21 | 4 | Female |

The workers table has 5 columns and 3 rows. We don't need any special tool to know that we have 3 workers, and it's easy to calculate the average age of all of them (29 + 32 + 21) / 3. But what happens when we have a thousand or even a million rows?

That's where databases and the SQL language come in. Databases store all of the tables, and SQL extracts the data.

**Challenge**

To extract the whole table from the database, we need to specify which columns to **SELECT** and **FROM** which table to extract.

To do this we'll write:

SELECT column1, column2, ... FROM table\_name

Look at the input on the workers table. For this challenge extract the whole table from the database.

Solution: SELECT firstName, lastName, age, exp\_years, gender FROM Workers

**Database concepts**

In databases, rows are called **records**, and columns are called **fields**.

Tables have a fixed number of fields (columns) but can contain many records (rows). Each field has a unique name, usually in lowercase and singular form. Tables typically include an id field, which serves as a unique identifier for each record, helping to distinguish between similar entries.

In SQL, we can use the asterisk \* symbol as a shortcut to select **all** columns from a table. Instead of listing each column name, simply write:

SELECT \* FROM table\_name

This query fetches every column in the specified table.

**Challenge**

Write an SQL query to retrieve all data from the objects table.

|  |  |  |  |
| --- | --- | --- | --- |
| **objects** | | | |
|  | **id** | **pieces** | **shape** |
| 1 | 251 | 3 | rectangle |
| 2 | 35 | 1 | circle |
| 3 | 39 | 23 | octagon |
| 4 | 21 | 5 | line |
| 5 | 1 | 5 | line |

Solution: SELECT \* FROM objects

**Unique values**

Let's assume we have the following table:

**sales**

|  | **country** | **city** | **amount** |
| --- | --- | --- | --- |
| 1 | Poland | Warsaw | 13 |
| 2 | Germany | Berlin | 24 |
| 3 | Poland | Katowice | 56 |

And we would like to know all of the countries where the product was sold.

If we use the normal query we know: SELECT country from sales it will return Poland, Germany, Poland. This is not what we are looking for because Poland is repeated twice.

To solve it we can use the DISTINCT keyword:

SELECT DISTINCT country FROM sales

**Challenge**

Fetch all of the unique **coins** that were used on the sales table below.

|  |  |  |
| --- | --- | --- |
| **sales** | | |
|  | **coin** | **amount** |
| 1 | AGK | 1.6 |
| 2 | GBL | 7.2 |
| 3 | KLQ | 3.3 |
| 4 | AGK | 1.9 |
| 5 | BPO | 6.3 |
| 6 | THL | 7.9 |

Solution: SELECT DISTINCT coin FROM sales

**Conditional statements part 1**

Sometimes we would like to fetch records that meet a certain condition.

For example

* fetch all of the records that have the family name "Aothly"
* fetch all of the records that the amount is bigger than 5
* fetch all of the records with the country "Mexico"

To add conditions we can use the **WHERE** keyword

For example here is a **sales** table:

|  |  |
| --- | --- |
| **coin** | **amount** |
| AGK | 13 |
| GOL | 21 |
| KLA | 15 |
| AGK | 18 |

To fetch all of the records with the coin "AGK" we will write:

SELECT \* FROM sales  
WHERE coin = "AGK"

To fetch all of the records with amount **smaller or equal** to 20 we will write:

SELECT \* FROM sales  
WHERE amount <= 20

**Challenge**

Fetch all of the event\_ids with less than 14 people.

|  |  |  |
| --- | --- | --- |
| **events** | | |
|  | **event\_id** | **people** |
| 1 | 1 | 9 |
| 2 | 6 | 23 |
| 3 | 9 | 5 |
| 4 | 13 | 7 |
| 5 | 2 | 28 |
| 6 | 4 | 11 |
| 7 | 99 | 22 |
| 8 | 83 | 7 |

Solution: SELECT event\_id FROM events

WHERE people < 14

**Conditional statements part 2**

Creating a query with only one condition is not sufficient. Sometimes we would like to check something more complicated. For that SQL (and many other programming languages) have the AND, OR, and NOT keywords to increase our ability to fetch the right result we need.

The AND and OR keywords are used like this:

SELECT col1, col2   
FROM table1  
WHERE condition1 AND condition2 OR condition3 ...

We can stack as many conditions as we want together.

| **people** | | |
| --- | --- | --- |
| **name** | **age** | **gender** |
| Joas | 13 | male |
| Holwa | 17 | male |
| Nohlas | 24 | female |
| Polar | 23 | male |
| Loopa | 18 | female |

The AND keyword means that **both** conditions must be true; if either of them is not, then the condition will not be met. For example, if we will write

SELECT \*   
FROM people  
WHERE gender = "female" AND age < 20

It means that we are looking for all records that the gender is "female" and the age is less than 20.

| **name** | **age** | **gender** |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Loopa | 18 | female |  |  |  |

This will be the result:

**Challenge:** Fetch all of the people who are between the ages of 20 and 28 (including 20 and 28).

|  |  |  |  |
| --- | --- | --- | --- |
| **people** | | | |
|  | **name** | **age** | **status** |
| 1 | Charles | 28 | employed |
| 2 | Fatima | 38 | unemployed |
| 3 | Eric | 11 | unemployed |
| 4 | Diya | 44 | employed |
| 5 | Hanna | 22 | employed |
| 6 | Ali | 20 | unemployed |

Solution: SELECT \* FROM people

WHERE age >= 20 AND age <= 28

**Conditional statements part 3**

The OR keyword means that we want one of the conditions will be true.

For example, if we take the same example from above and change the AND keyword to OR

SELECT \*   
FROM people  
WHERE gender = "female" OR age < 20

| **people** | | |
| --- | --- | --- |
| **name** | **age** | **gender** |
| Joas | 13 | male |
| Holwa | 17 | male |
| Nohlas | 24 | female |
| Loopa | 18 | female |

It means that we are looking for all records that either the gender is female or the age is less than 20. This will be the result:

The NOT keywords mean that we don't want the condition to be met.

For example, if we write:

SELECT \*   
FROM people  
WHERE NOT gender = "male"

| **name** | **age** | **gender** |
| --- | --- | --- |
| Nohlas | 24 | female |
| Loopa | 18 | female |

This will be the result:

It is important to use parenthesis when combining different conditions because:

WHERE age > 20 AND age < 30 OR gender = 'female'

WHERE age > 20 AND (age < 30 OR gender = 'female')

**N: B:** These are not the same thing and conditions are also different.

The first query will return all people aged 21-29 (regardless of gender) AND all females (regardless of age). The second query will return all people over 20 who are either under 30 OR female.

**Challenge**

Fetch all of the people who are either unemployed or between the ages of 20 and 28 (including 20 and 28) but not age 22.

|  |  |  |  |
| --- | --- | --- | --- |
| **people** | | | |
|  | **name** | **age** | **status** |
| 1 | Charles | 28 | employed |
| 2 | Fatima | 38 | unemployed |
| 3 | Eric | 11 | unemployed |
| 4 | Diya | 44 | employed |
| 5 | Hanna | 22 | employed |
| 6 | Ali | 20 | unemployed |
| 7 | Gabriel | 37 | employed |
| 8 | Beatriz | 17 | employed |
| 9 | Troy | 29 | unemployed |
| 10 | Angelica | 32 | employed |

Solution:

SELECT \* FROM people

WHERE status = 'unemployed' OR age >= 20 AND age != 22 AND age <= 28

**Conditional statements part 4**

Conditions are booleans. Boolean is a data type with two possible values: TRUE or FALSE.

For example

* 10 > 100 - FALSE
* 10 > 5 - TRUE
* 10 > 5 AND 100 < 5 - FALSE

Boolean columns have only two values - either 1 or 0. TRUE indicates 1 and FALSE indicates 0

We can replace columns such as employed or unemployed to 1 or 0 to make it easier to filter data. To filter data using booleans we will use the IS TRUE or IS NOT TRUE keywords.

SELECT \*  
FROM table1  
WHERE col1 IS NOT FALSE AND col2 IS TRUE

**Challenge**

|  |  |  |
| --- | --- | --- |
| **objects** | | |
|  | **id** | **colorful** |
| 1 | 988 | 1 |
| 2 | 989 | 1 |
| 3 | 990 | 0 |
| 4 | 991 | 0 |
| 5 | 992 | 1 |
| 6 | 993 | 0 |
| 7 | 994 | 0 |
| 8 | 995 | 0 |
| 9 | 996 | 1 |
| 10 | 997 | 0 |

Fetch all of the colorful objects. Instead of writing colorful = 1 try to use the TRUE keyword.

SOLUTION:

SELECT \* FROM objects

WHERE colorful = 1 IS TRUE

**Sort results**

The results might be confusing. Showing them in an ascending or descending order can greatly improve our data analysis.

**competition**

| **runner\_id** | **age** | **avg\_speed** |
| --- | --- | --- |
| 1 | 47 | 3.65 |
| 2 | 62 | 3.07 |
| 3 | 57 | 6.82 |
| 4 | 56 | 4.34 |
| 5 | 25 | 4.93 |
| 6 | 40 | 3.94 |
| 7 | 23 | 6.58 |
| 8 | 40 | 3.43 |

To sort the result we use the ORDER BY keyword and after that, we should specify by which field we are ordering

For example

SELECT \*  
FROM competition  
WHERE age > 50  
ORDER BY avg\_speed

| **runner\_id** | **age** | **avg\_speed** |
| --- | --- | --- |
| 2 | 62 | 3.07 |
| 4 | 56 | 4.34 |
| 3 | 57 | 6.82 |

by default, it sorts by ascending order.

The result on the right side:

To specify how to sort that data we can add DESC or ASC keywords after the name of the column.

ORDER BY avg\_speed ASC

We can even specify multiple columns to sort. For example:

SELECT \*  
FROM competition  
WHERE age < 50  
ORDER BY age DESC, avg\_speed DESC

It will first be sorted by age in descending order and if there are two equal values then it will sort those records by the avg\_speed in descending order

The result from the competition table:

| **runner\_id** | **age** | **avg\_speed** |
| --- | --- | --- |
| 1 | 47 | 3.65 |
| 8 | 40 | 3.43 |
| 6 | 40 | 3.94 |
| 5 | 25 | 4.93 |
| 7 | 23 | 6.58 |

**Challenge**

|  |  |  |
| --- | --- | --- |
| **feathers** | | |
|  | **id** | **weight** |
| 1 | 1 | 0.01 |
| 2 | 2 | 0.13 |
| 3 | 3 | 0.03 |
| 4 | 4 | 0.09 |
| 5 | 5 | 0.002 |
| 6 | 6 | 0.21 |
| 7 | 7 | 0.35 |
| 8 | 8 | 0.0045 |
| 9 | 9 | 0.062 |

Return all of the **id**’s after ordering them by the weight in descending order.

SOLUTION:

SELECT id FROM feathers

ORDER BY weight DESC

**Limit number of records**

Let's assume we fetched a lot of data. Sometimes we only need the top 5 or the top 10 records.

To limit the number of records we can use the LIMIT keyword. For example:

SELECT \*  
FROM table1  
LIMIT 10

|  |  |  |
| --- | --- | --- |
| **temperature** | | |
|  | **place\_id** | **avg\_temp** |
| 1 | 1 | -21 |
| 2 | 2 | -13 |
| 3 | 3 | -9 |
| 4 | 4 | 23 |
| 5 | 5 | -1 |
| 6 | 6 | 0 |
| 7 | 7 | 6 |
| 8 | 8 | 4 |
| 9 | 9 | 15 |
| 10 | 10 | -12 |

This will return the top 10 records.

**Challenge**

Fetch the 5 coldest places from the temperature table

SOLUTION:

SELECT \* FROM temperature

ORDER BY avg\_temp ASC

LIMIT 5

**Null values**

In the real world, we might have fields with no values. A field with no value is called null. We can manipulate our query using IS NULL or IS NOT NULL to fetch relevant data. For example:

SELECT \*  
FROM table1  
WHERE col1 IS NULL

|  |  |
| --- | --- |
| **people** | |
|  | **name** |
| 1 |  |
| 2 | Roy |
| 3 | Dani |
| 4 | Esther |
| 5 | Bestie |
| 6 |  |
| 7 | Mash |
| 8 |  |
| 9 |  |
| 10 | Olivier |

Will return all of the records where col1 has no value.

**Challenge**

Fetch all of the unique names without missing values.

SOLUTION:

SELECT \* FROM people

WHERE name IS NOT NULL

**Recap challenge #1**

|  |  |  |  |
| --- | --- | --- | --- |
| **employees** | | | |
|  | **id** | **salary** | **status** |
| 1 | 1 | 2016 | married |
| 2 | 2 | 5903 | single |
| 3 | 3 | 7608 | married |
| 4 | 4 | 6448 | single |
| 5 | 5 | 9551 | married |
| 7 | 7 | 5753 | single |
| 8 | 8 | 7313 | single |
| 9 | 9 | 4219 | single |
| 10 | 10 | 3140 | married |
| 11 | 11 | 2702 | married |
| 12 | 12 | 3035 | single |
| 13 | 13 | 7590 | single |
| 14 | 14 | 3404 | married |
| 15 | 15 | 4551 | married |

**Challenge**

As an owner of a vehicle factory, you have agreed to provide a salary raise for the four employees with the lowest salaries who are also married, as they are struggling to finance their families. Return only the IDs of the relevant employees. Sort the results by salary in ascending order.

SOLUTION:

SELECT id FROM employees

WHERE status = 'married'

ORDER BY salary ASC

limit 4

**Challenge**

You have a cyber-security firm that experienced an arbitrary attack, resulting in all of your systems shutting down. To solve this issue, you need to identify all of the events that appear suspicious. A suspicious event meets **one or more of the following criteria**:

1. Its size is significantly different from the average normal event size of 50MB (you'll need to analyze the data in the table to determine the thresholds for 'too small' and 'too big')
2. It was created before the year 2000
3. It has a missing name

Your task:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **events** | | | | |
|  | **id** | **name** | **size** | **year** |
| 1 | 153 | foat | 43 | 2009 |
| 2 | 154 | antiMAL | 70 | 1999 |
| 3 | 155 | devdev | 1009 | 2011 |
| 4 | 156 |  | 53 | 2005 |
| 5 | 157 | hacker | 0.02 | 2010 |
| 6 | 158 | log15234 | 72 | 1051 |
| 7 | 159 | plural | 9999 | 2055 |
| 8 | 160 | system | 0.5 | 2001 |
| 9 | 161 | system182 | 35 | 2009 |
| 10 | 162 | system124 | 85 | 2013 |
| 11 | 163 | virus | 10021 | 0 |
| 12 | 164 | svg | 55 | 2023 |
| 13 | 165 | system982 | 45 | 2023 |
| 14 | 166 | photio | 53 | 2016 |
| 15 | 167 | favicon | 49 | 2016 |
| 16 | 168 | system | 0.002 | 2049 |
| 17 | 169 |  | 50 | 1209 |
| 18 | 170 | server host | 49 | 2015 |
| 19 | 171 | boot | 9102 | 2000 |
| 20 | 172 | angryBOT | 0.001 | 9999 |

1. Examine the provided table of events to determine what should be considered 'too small' or 'too big' based on the distribution of event sizes.
2. Identify all suspicious events based on the criteria mentioned above.
3. Return the event IDs and their names in descending order by their ID.

**Note**: The exact thresholds for 'too small' and 'too big' should be inferred from the data. Look for patterns or outliers in the event sizes to make this determination."

SOLUTION:

SELECT id, name FROM events

-- Write your code below --

WHERE size < 1 OR size > 1000 OR year < 2000 OR name IS NULL

ORDER BY id DESC;

**The IN keyword**

The following query is very long:

SELECT \*  
FROM table1  
WHERE col1 = 'a' OR col1 = 'b' OR col1 = 'c' OR col1 = 'd' OR ...

We can simplify it by using the IN keyword like this:

SELECT \*  
FROM table1  
WHERE col1 IN ('a', 'b', 'c', 'd', 'e', 'f')

|  |  |  |  |
| --- | --- | --- | --- |
| **countries** | | | |
|  | **location\_x** | **location\_y** | **country** |
| 1 | 53.39 | 27.53 | Belarus |
| 2 | 57.18 | 24.96 | Latvia |
| 3 | -25.64 | 134.25 | Australia |
| 4 | 20.33 | 55.85 | Oman |
| 5 | 3.59 | 45.45 | Somalia |
| 6 | 12.85 | -85.32 | Nicaragua |
| 7 | 27.26 | 90.5 | Bhutan |
| 8 | 36.65 | 139.61 | Japan |
| 9 | 14.52 | -14.47 | Senegal |
| 10 | 39.39 | -3.21 | Spain |

**Challenge**

Return all the records from the following countries:

Oman, Nicaragua, Bhutan, Senegal, Belarus.

SOLUTION:

SELECT \* FROM countries

WHERE country IN ('Oman', 'Nicaragua', 'Bhutan', 'Senegal', 'Belarus')

|  |  |  |
| --- | --- | --- |
| **temperature** | | |
|  | **place\_id** | **avg\_temp** |
| 1 | 1 | -21 |
| 2 | 2 | -13 |
| 3 | 3 | -9 |
| 4 | 4 | 23 |
| 5 | 5 | -1 |
| 6 | 6 | 0 |
| 7 | 7 | 6 |
| 8 | 8 | 4 |
| 9 | 9 | 15 |
| 10 | 10 | -12 |

**Challenge**

Fetch the 5 coldest places from the temperature table.

SOLUTION:

SELECT \* FROM  temperature

ORDER BY avg\_temp ASC

LIMIT 5

**The BETWEEN keyword**

As of now, we learned to use bigger > and smaller < to demand a range for a field. But there is another way.

|  |  |
| --- | --- |
| **data** | |
|  | **value** |
| 1 | 13 |
| 2 | 3 |
| 3 | 5 |
| 4 | 9 |
| 5 | 2 |
| 6 | 7 |
| 7 | 21 |
| 8 | 10 |

Instead of writing col1 >= 5 AND col1 <= 10 we can write: col1 BETWEEN 5 AND 10

**Challenge**

Fetch all of the records between 5 and 10.

SOLUTION:

SELECT \* FROM data

WHERE value BETWEEN 5 AND 10

/\* Instead of -– value >= 5 AND value <= 10 \*/

**The LIKE keyword**

The LIKE keyword is used to check the similarities of strings. For example, if we want to fetch all of the records that the name starts with the letter a then we will use the LIKE keyword.

Two main wildcards are used:

* % - means any number of characters
* \_ - means exactly one character

For example:

* %a means any string that ends with a
* a% means any string that starts with a
* %a% means any string that contains a
* \_a% means that the letter a is the second character in the string
* %a\_\_ means that the string contains a in the 3rd from last place

 To use it we will write:

SELECT col1, col2, ...  
FROM table1  
WHERE col1 LIKE '%a\_\_'

/\* Or examples, ‘%a’, ‘a%’, ‘%a%’, ‘\_a%’ \*/

|  |  |  |
| --- | --- | --- |
| **people** | | |
|  | **id** | **name** |
| 1 | 13 | Jhon |
| 2 | 14 | Kayle |
| 3 | 15 | Kyla |
| 4 | 16 | Somala |
| 5 | 17 | Katarina |
| 6 | 18 | Koa |
| 7 | 19 | Olerrte |
| 8 | 20 | Kassandra |
| 9 | 21 | Kirra |
| 10 | 22 | Koval |

**Challenge**

Fetch all of the people that their name starts with k and ends with a and order the results by the names in descending.

SOLUTION:

SELECT \* FROM people

WHERE name LIKE 'k%a'

ORDER BY name DESC

|  |  |  |  |
| --- | --- | --- | --- |
| **employees** | | | |
|  | **id** | **salary** | **status** |
| 1 | 1 | 2016 | married |
| 2 | 2 | 5903 | single |
| 3 | 3 | 7608 | married |
| 4 | 4 | 6448 | single |
| 5 | 5 | 9551 | married |
| 6 | 6 | 6505 | married |
| 7 | 7 | 5753 | single |
| 8 | 8 | 7313 | single |
| 9 | 9 | 4219 | single |
| 10 | 10 | 3140 | married |
| 11 | 11 | 2702 | married |
| 12 | 12 | 3035 | single |
| 13 | 13 | 7590 | single |
| 14 | 14 | 3404 | married |
| 15 | 15 | 4551 | married |

**Challenge**

As an owner of a vehicle factory, you have agreed to provide a salary raise for the four employees with the lowest salaries who are also married, as they are struggling to finance their families. Return only the IDs of the relevant employees. Sort the results by salary in ascending order.

SOLUTION:

SELECT id FROM employees

WHERE status = 'married'

ORDER BY salary ASC

LIMIT 4

**Aliases**

Column names are important to present data in a meaningful way. If you show a table with bad column names it will be hard for your audience to understand what are you talking about. To change column names you may use the AS keyword.

SELECT col1 AS firstColumn, col2 AS secondColumn, ...  
FROM table1

|  |  |  |
| --- | --- | --- |
| **kitchen\_items** | | |
|  | **cutlery** | **amount** |
| 1 | knife | 3 |
| 2 | spoon | 13 |
| 3 | fork | 9 |
| 4 | toothpick | 49 |
| 5 | straw | 32 |
| 6 | chopsticks | 14 |
| 7 | nutcracker | 1 |
| 8 | spatula | 2 |
| 9 | rolling pin | 1 |
| 10 | honey dipper | 1 |

**Challenge**

Fetch all of the kitchen items that the cutlery have less than 3 items. Change the cutlery column name to silverware .

SOLUTION:

SELECT cutlery AS silverware,

amount AS amount FROM kitchen\_items

WHERE amount < 3