

ITCS393 Database Systems Lab

Aggregation, GROUP BY, HAVING

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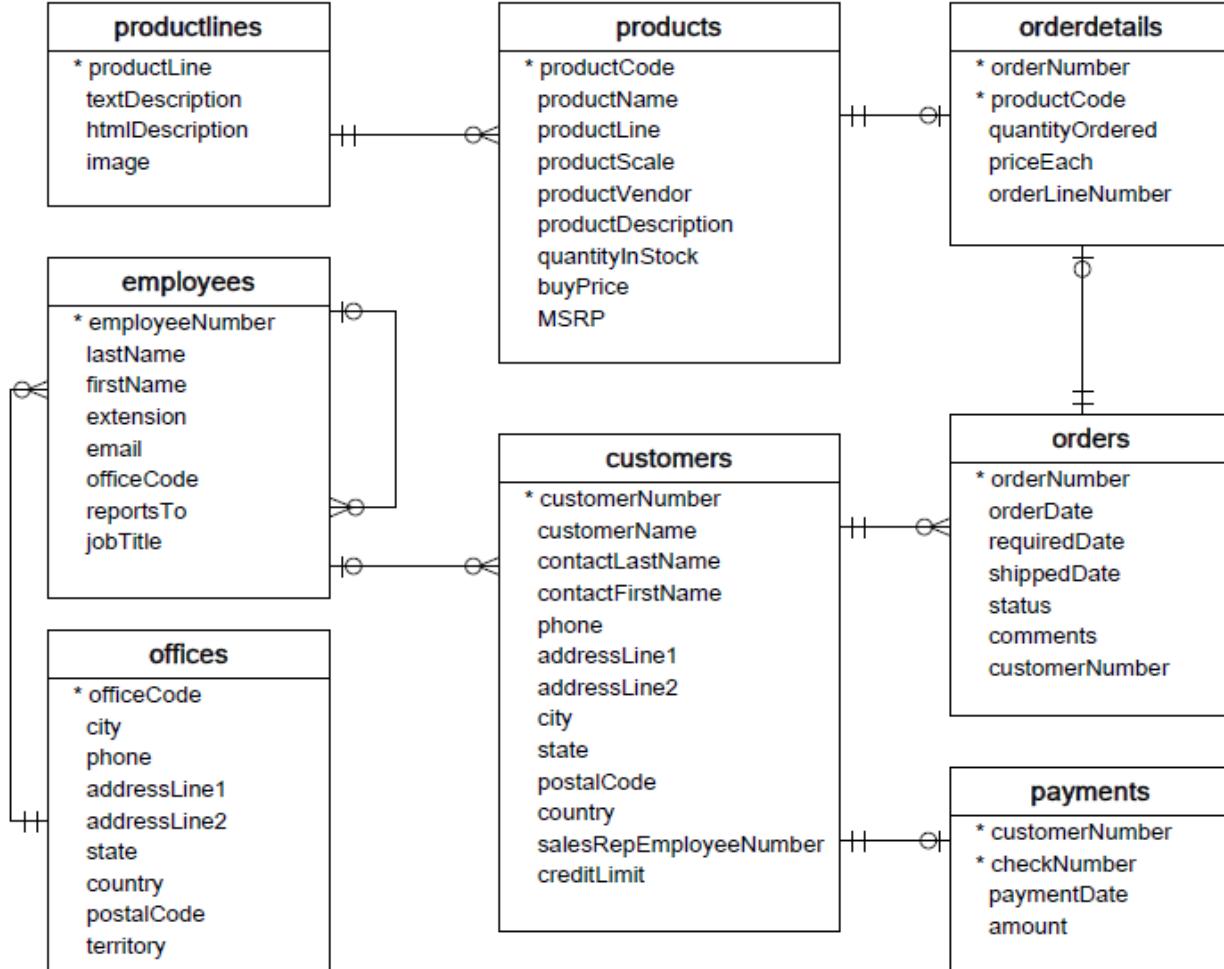
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Overview

- To focus on **aggregated functions** in SQL
- To learn how to use aggregated functions with a **GROUP BY** clause in SQL
- To learn how to use **HAVING** clause in SQL

Database: classicmodels

.sql script is provided in MyCourses



- **Customers:** stores customer's data.
- **Products:** stores a list of scale model cars.
- **ProductLines:** stores a list of product line categories.
- **Orders:** stores sales orders placed by customers.
- **OrderDetails:** stores sales order line items for each sales order.
- **Payments:** stores payments made by customers based on their accounts.
- **Employees:** stores all employee information as well as the organization structure such as who reports to whom.
- **Offices:** stores sales office data.

RECAP: SQL Syntax

```
SELECT [DISTINCT] [columns] [AS alias]  
FROM tablename  
[INNER JOIN tablename2 ON conditions]  
[WHERE conditions]  
[GROUP BY [columns]]  
[HAVING [conditions]]  
[ORDER BY [columns] ASC|DESC]  
[LIMIT N];
```

Example: SQL Operators

Functions	Description
+ - * / %	Arithmetic operators
= > < >= <= <>	Comparison operators
AND OR NOT	Logical operators
BETWEEN	TRUE if the operand is within the range of comparisons
IN	Match multiple values in a WHERE clause (i.e., multiple OR conditions)
LIKE	Search for a specified pattern in a column with wildcards <ul style="list-style-type: none">The percent sign (%) represents zero, one, or multiple charactersThe underscore sign (_) represents one, single character

Ref: https://www.w3schools.com/sql/sql_ref_mysql.asp

Example: SQL String Functions

Functions	Description
CONCAT	Return concatenated string
LEFT	Return the leftmost number of characters as specified
LOWER	Return the argument in lowercase
LTRIM	Remove leading spaces
REPLACE	Replace occurrences of a specified string
RIGHT	Return the specified rightmost number of characters
RTRIM	Remove trailing spaces
TRIM	Remove leading and trailing spaces
UPPER	Convert to uppercase

Ref: https://www.w3schools.com/sql/sql_ref_mysql.asp

Example: SQL Numeric Functions

Functions	Description
ABS	Return the absolute value
POW	Return the argument raised to the specified power
ROUND	Round the number to to a specified number of decimal places.
FLOOR	Returns the largest integer value that is <= to a number
CEIL	Return the smallest integer value that is >= to a number
TRUNCATE	Truncates a number to the given number of decimal places
EXP	Returns e raised to the power of a specified number
LOG10	Returns the natural logarithm of a number to base 10
RAND	Returns a random number

Ref: https://www.w3schools.com/sql/sql_ref_mysql.asp

Example: SQL Date Functions

Functions	Description
CURDATE	Return the current date
CURTIME	Return the current time
NOW	Return current date and time
DATE	Extracts the date part of the date or datetime expression
DATEDIFF	Subtract two dates
YEAR	Return the year part of a date
MONTH	Return the month part of a date
DAY	Return the day part of a date
MONTHNAME	Return the name of the month for a date:
DAYOFWEEK	Returns the weekday index for a date (a number from 1-Sun to 7-Sat)

Ref: https://www.w3schools.com/sql/sql_ref_mysql.asp

Aggregate Functions

- Aggregate functions are used to summarize data

Functions	Description
COUNT	Count number of not-null values of an attribute
MAX	Find highest value in a table
MIN	Find lowest value in a table
SUM	Compute total sum for any specified attribute
AVG	Compute the average value of any specified attribute
STDDEV	Compute the population standard deviation

Ref: <https://dev.mysql.com/doc/refman/8.0/en/aggregate-functions.html>

Aggregate Function: COUNT

- Used to find the total number *not-null* values of an attribute.

Example

```
SELECT *
FROM Employees
WHERE jobTitle LIKE '%Manager%';
```

List all managers in the company

employeeNumber | lastName | firstName | extension | email

officeCode | reportsTo | jobTitle

1088	Patterson	William	x4871	wpatterson@classicmodelcars.com	6	1056	Sales Manager (APAC)
1102	Bondur	Gerard	x5408	gbondur@classicmodelcars.com	4	1056	Sale Manager (EMEA)
1143	Bow	Anthony	x5428	abow@classicmodelcars.com	1	1056	Sales Manager (NA)

```
SELECT COUNT(*) AS numManager
FROM Employees
WHERE jobTitle LIKE '%Manager%';
```

How many employee who are managers?

numManager

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Aggregate Function: COUNT (cont.)

- Can be used in conjunction with the **DISTINCT** clause

selecting non-duplicate value

Example How many product vendors in this company?

```
SELECT DISTINCT productVendor  
FROM Products;
```

productVendor
Min Lin Diecast
Classic Metal Creations
Highway 66 Mini Classics
Red Start Diecast
Motor City Art Classics
Second Gear Diecast
Autoart Studio Design
Welly Diecast Productions
Unimax Art Galleries
Studio M Art Models
Exoto Designs
Gearbox Collectibles
Carousel DieCast Legends

```
SELECT COUNT (DISTINCT productVendor)  
AS numVendor  
FROM Products;
```

numVendor
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Aggregate Function: MAX, MIN SUM, AVG

Example:

Find the total , minimum, average, and maximum amount of payments of this company in the year 2004.

```
SELECT SUM(amount), MIN(amount), AVG(amount), MAX(amount)  
FROM Payments  
WHERE YEAR(paymentDate)=2004;
```

SUM(amount)	MAX(amount)	AVG(amount)	MIN(amount)
4313328.25	116208.40	31715.648897	1676.14

Aggregate Function: STDDEV

- Standard deviation is a statistical measure of diversity or variability in a data set.
 - Low SD means data points are closed to the mean
 - High SD indicates greater variability in data points

$$SD = \sqrt{\frac{\sum |x - \mu|^2}{N}}$$

(productLine)

Example: What is the average and standard deviation of MSRP of the "Classic Cars"?

```
SELECT AVG(MSRP) , FORMAT(STDDEV(MSRP) , 2)
FROM Products
WHERE productLine='Classic Cars';
```

AVG(MSRP)	FORMAT(STDDEV(MSRP),2)
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118.021053	44.49
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Aggregate Function per Group

- The aggregate functions can be used to summarize data based on group

Example: How many products per vendor?

productCode	productName	productLine	productScale	productVendor	productDescription
S12_1099	1968 Ford Mustang	Classic Cars	1:12	Autoart Studio Design	Hood, doors and trunk all open to reveal highly... Vendor 1
S18_2325	1932 Model A Ford J-Coupe	Vintage Cars	1:18	Autoart Studio Design	This model features grille-mounted chrome horn...
S24_1578	1997 BMW R 1100 S	Motorcycles	1:24	Autoart Studio Design	Detailed scale replica with working suspension...
S24_2300	1962 Volkswagen Microbus	Trucks and Buses	1:24	Autoart Studio Design	This 1:18 scale die cast replica of the 1962 Mic...
S24_2841	1900s Vintage Bi-Plane	Planes	1:24	Autoart Studio Design	Hand crafted diecast-like metal bi-plane is re-cr...
S24_3420	1937 Horch 930V Limousine	Vintage Cars	1:24	Autoart Studio Design	Features opening hood, opening doors, opening...
S50_4713	2002 Yamaha YZR M1	Motorcycles	1:50	Autoart Studio Design	Features rotating wheels , working kick stand. C...
S700_1138	The Schooner Bluenose	Ships	1:700	Autoart Studio Design	All wood with canvas sails. Measures 31 1/2 inc...
S18_2432	1926 Ford Fire Engine	Trucks and Buses	1:18	Carousel DieCast Legends	Gleaming red handsome appearance. Everythin... Vendor 2
S18_2949	1913 Ford Model T Speedster	Vintage Cars	1:18	Carousel DieCast Legends	This 250 part reproduction includes moving han...
S18_3259	Collectable Wooden Train	Trains	1:18	Carousel DieCast Legends	Hand crafted wooden toy train set is in about 1:...
S24_1628	1966 Shelby Cobra 427 S/C	Classic Cars	1:24	Carousel DieCast Legends	This diecast model of the 1966 Shelby Cobra 42...
S24_2011	18th century schooner	Ships	1:24	Carousel DieCast Legends	All wood with canvas sails. Many extras includin...
S24_2840	1958 Chevy Corvette Limited Edition	Classic Cars	1:24	Carousel DieCast Legends	The operating parts of this 1958 Chevy Corvette...
S24_3816	1940 Ford Delivery Sedan	Vintage Cars	1:24	Carousel DieCast Legends	Chrome Trim, Chrome Grille, Opening Hood, O...
S700_2824	1982 Camaro Z28	Classic Cars	1:18	Carousel DieCast Legends	Features include opening and closing doors. Co...
S700_3505	The Titanic	Ships	1:700	Carousel DieCast Legends	Completed model measures 19 1/2 inches long...
S10_1949	1952 Alpine Renault 1300	Classic Cars	1:10	Classic Metal Creations	Turnable front wheels; steering function; detaile...
S18_1589	1965 Aston Martin DB5	Classic Cars	1:18	Classic Metal Creations	Die-cast model of the silver 1965 Aston Martin...

Aggregate Function with GROUP BY

GROUP BY: Group rows into smaller collections by given columns, then, apply aggregate functions to summarize the data in each group

Note: the **GROUP BY** clause is valid only when used in conjunction with one of the **SQL aggregate** functions

Example:

How many products **per vendor?**

```
SELECT productVendor,  
       COUNT(productCode) as numProd  
FROM Products  
GROUP BY productVendor  
ORDER BY productVendor;
```

productVendor	numProd
Autoart Studio Design	8
Carousel DieCast Legends	9
Classic Metal Creations	10
Exoto Designs	9
Gearbox Collectibles	9
Highway 66 Mini Classics	9
Min Lin Diecast	8
Motor City Art Classics	9
Red Start Diecast	7
Second Gear Diecast	8
Studio M Art Models	8
Unimax Art Galleries	8
Welly Diecast Productions	8

GROUP BY with HAVING

- The **HAVING** clause operates like the **WHERE** clause of the **GROUP BY** clause

Only applied to the output of a **GROUP BY** operation

Example

What vendors **providing exactly 8 products**?

```
SELECT productVendor,  
       COUNT(productCode) as numProd  
FROM products  
GROUP BY productVendor  
HAVING numProd=8  
ORDER BY productVendor;
```

productVendor	numProd
Autoart Studio Design	8
Min Lin Diecast	8
Second Gear Diecast	8
Studio M Art Models	8
Unimax Art Galleries	8
Welly Diecast Productions	8

