

SQL × DML

64

Data Manipulation Language to

INSERT ✕

UPDATE ✕

DELETE ✕

SELECT

6

from tables.

SQL \times DML \times **SELECT** (Relational Algebra) 65

Operations in relational algebra , i.e.,

Project(π)

Select(σ)

Rename(ρ)

Union(\cup)

Set Difference(\setminus)

Cartesian Product(\times)

Intersection(\cap), Division, Joins, ...

Only by one statement!

SQL \times DML \times **SELECT** \times Project(π)

66

2 **SELECT** ***** | *ColumnName1*,
ColumnName2,
...
ColumnNameN

1 **FROM** *TableName*

π *ColumnName1, ColumnName2, ..., ColumnNameN* (*TableName*)

SQL × DML × **SELECT** × Project(π)

67

Director						
<u>Id</u>	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

What are directors' name?

$\pi_{\text{FirstName, LastName}}(\text{Director})$

SELECT FirstName, LastName FROM Director

SQL × DML × **SELECT** × Project(π)

68

Director						
<u>Id</u>	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

How many movies each director made?

π FirstName, LastName, MovieCount (Director)

SELECT FirstName, LastName, MovieCount **FROM** Director

SQL \times DML \times SELECT \times Project(π)

69

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

All information about directors?

π Id, FirstName, LastName, ..., MovieCount (Director)

SELECT * FROM Director

SQL \times DML \times SELECT \times Select(σ)

70

3 SELECT * | ColumnName1,
ColumnName2,
...
ColumnNameN

1 FROM TableName

2 WHERE θ

$\pi_{\text{ColumnName1, ColumnName2, ..., ColumnNameN}}(\sigma_{\theta}(\text{TableName}))$

SQL × DML × **SELECT** × Select(σ)

71

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Which director was born in US?

$\sigma_{\text{PlaceOfBirth}='USA'}(\text{Director})$

SELECT * **FROM** Director **WHERE** PlaceOfBirth = 'USA'

SQL × DML × **SELECT** × Select(σ)

72

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Which American director made more than 20 movies or is not American?

$\sigma_{(\text{PlaceOfBirth}='USA' \text{ AND } \text{MovieCount} > 20) \text{ OR } (\text{PlaceOfBirth} \neq 'USA')(\text{Director})}$

SELECT * **FROM** Director

WHERE (PlaceOfBirth='USA' **AND** MovieCount > 20)

OR (PlaceOfBirth <> 'USA')

SQL × DML × **SELECT** × Select(σ)

73

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Which director made between 10 and 40 movies?

$\sigma_{\text{MovieCount} \geq 10 \text{ AND } \text{MovieCount} \leq 40}(\text{Director})$

SELECT * **FROM** Director

WHERE MovieCount ≥ 10 **AND** MovieCount ≤ 40

SQL × DML × **SELECT** × Select(σ)

74

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Which director made between 10 and 40 movies?

$\sigma_{\text{MovieCount} \geq 10 \text{ AND MovieCount} \leq 40}(\text{Director})$

SELECT * **FROM** Director

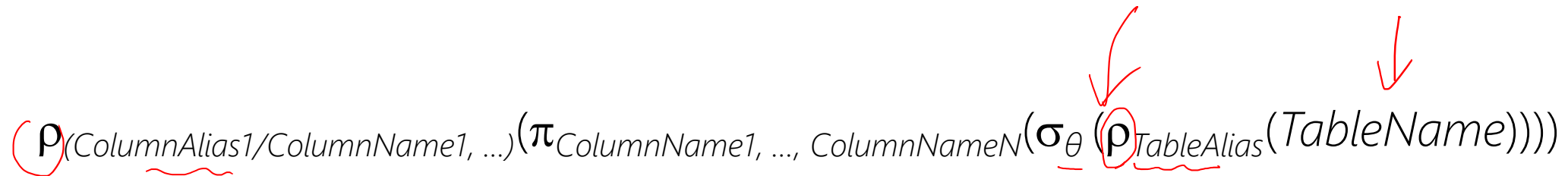
WHERE MovieCount **BETWEEN** 10 **AND** 40

SQL \times DML \times SELECT \times Rename(ρ)

75

3 SELECT * | ColumnName1 AS ColumnAlias1,
 ColumnName2 AS ColumnAlias2,
 ...
 ColumnNameN AS ColumnAliasN
1 FROM TableName AS TableAlias
2 WHERE θ

$(\rho_{(\text{ColumnAlias1/ColumnName1, ...})}(\pi_{\text{ColumnName1, ..., ColumnNameN}}(\sigma_{\theta}(\rho_{\text{TableAlias}}(\text{TableName}))))$



SQL × DML × **SELECT** × Rename(p)

76

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Find American directors' name and movie count?

SELECT DFirstName, DLastName **AS** FamilyName, D.MovieCount

FROM Director **AS** D *Alias*

WHERE DPlaceOfBirth = 'USA'

<u>D</u>		
FirstName	FamilyName	MovieCount
Stanley	Kubrick	13
Clint	Eastwood	35

SQL × DML × **SELECT** × Union(∪)

77

- 1 (SELECT ...)
- 3 UNION
- 2 (SELECT ...)

SQL × DML × **SELECT** × Union(\cup)

78

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Actor						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestLine	MovieCount
1	John	Travolta	Feb. 18, 1954	USA	You ...	61
2	Samuel	Jackson	Dec. 21, 1948	USA	Say 'w...	125
3	Uma	Thurman	Apr. 29, 1970	USA	I believe ..	51
4	Clint	Eastwood	May 31, 1930	USA	A good ..	69

$\pi_{\text{FirstName, LastName}}(\sigma_{\text{PlaceOfBirth}='USA'}(\text{Actor})) \cup \pi_{\text{FirstName, LastName}}(\sigma_{\text{PlaceOfBirth}='USA'}(\text{Director}))$

SQL × DML × **SELECT** × Union(∪)

79

FirstName	LastName
Stanley	Kubrick
Clint	Eastwood
John	Travolta
Samuel	Jackson
Uma	Thurman

(**SELECT** FirstName, LastName **FROM** Director **WHERE** PlaceOfBirth='USA')
UNION ←

(**SELECT** FirstName, LastName **FROM** Actor **WHERE** PlaceOfBirth='USA')
UNION

~~(**SELECT** FirstName, LastName **FROM** Director **UNION** Actor **WHERE** PlaceOfBirth='USA')~~ ❌ ❌

SQL × DML × SELECT × Union(∪)

80

FirstName	LastName
Stanley	Kubrick
Clint	Eastwood
John	Travolta
Samuel	Jackson
Uma	Thurman
Clint	Eastwood

MC
5
6
7
8

(SELECT FirstName, LastName FROM Director WHERE PlaceOfBirth='USA')
UNION ALL
(SELECT FirstName, LastName FROM Actor WHERE PlaceOfBirth='USA')

SQL × DML × **SELECT** × Intersection(\cap) 81

1 (SELECT ...)
3 INTERSECT
2 (SELECT ...)

SQL \times DML \times **SELECT** \times Intersection(\cap) 82

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Actor						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestLine	MovieCount
1	John	Travolta	Feb. 18, 1954	USA	You ...	61
2	Samuel	Jackson	Dec. 21, 1948	USA	Say 'w...	125
3	Uma	Thurman	Apr. 29, 1970	USA	I believe ..	51
4	Clint	Eastwood	May 31, 1930	USA	A good ..	69

Which actor has directed a movie?

$\pi_{\text{FirstName, LastName}}(\text{Actor}) \cap \pi_{\text{FirstName, LastName}}(\text{Director})$



SQL \times DML \times SELECT \times Intersection(\cap) 83

FirstName	LastName
Clint	Eastwood

(SELECT FirstName, LastName FROM Director)

INTERSECT 

(SELECT FirstName, LastName FROM Actor)

~~SELECT FirstName, LastName FROM Director INTERSECT Actor~~  

SQL × DML × **SELECT** × Set Diff(\)

84

① (SELECT ...) A
③ EXCEPT
② (SELECT ...) B

A \ B

SQL × DML × **SELECT** × Set Diff(\)

85

Director						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestMovieId	MovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	1	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Actor						
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	BestLine	MovieCount
1	John	Travolta	Feb. 18, 1954	USA	You ...	61
2	Samuel	Jackson	Dec. 21, 1948	USA	Say 'w...	125
3	Uma	Thurman	Apr. 29, 1970	USA	I believe ..	51
4	Clint	Eastwood	May 31, 1930	USA	A good ..	69

Which director never appeared in a movie?

$\pi_{\text{FirstName, LastName}}(\text{Director}) \setminus (\pi_{\text{FirstName, LastName}}(\text{Actor}))$

SQL × DML × **SELECT** × Set Diff(\)

86

FirstName	LastName
Stanley	Kubrick
Alfred	Hitchcock

(**SELECT** FirstName, LastName **FROM** Director)

EXCEPT

(**SELECT** FirstName, LastName **FROM** Actor)

~~**SELECT** FirstName, LastName **FROM** Director **EXCEPT** Actor~~ ✖

SQL × DML × **SELECT** × Product(x)

87

3 SELECT Column List

1 FROM TableName1, TableName2, ..., TableNameN

2 WHERE θ

$\pi_{\langle \text{Column List} \rangle}(\sigma_{\theta}(\text{TableName1} \times \text{TableName2} \times \dots \times \text{TableNameN}))$

SQL \times DML \times SELECT \times Product(\times)

89

<u>Id</u>	<u>Title</u>	<u>Language</u>	<u>RunningTime</u>	<u>MovieId</u>	<u>GenreId</u>	<u>Id</u>	<u>Title</u>
1	2001: A Space Odyssey	English	142	1	1	1	Sci-fi
1	2001: A Space Odyssey	English	142	1	3	3	Adventure

$\sigma_{\text{Genre.Id}=\text{GenreId}}(\sigma_{\text{Movie.Id}=\text{MovieId} \text{ AND } \text{Title}='2001: A Space Odyssey'}(\text{Movie} \times \text{MovieGenre})) \times \text{Genre}$

Corollary: $\sigma_{\theta}(\sigma_{\theta'}(\sigma_{\theta''}(\sigma_{\theta'''}(R))) = \sigma_{\theta \text{ AND } \theta' \text{ AND } \theta'' \text{ AND } \theta'''(R)}$

$\sigma_{\text{Title}='2001: A Space Odyssey' \text{ AND } \text{Movie.Id}=\text{MovieId} \text{ AND } \text{Genre.Id}=\text{GenreId}}(\text{Movie} \times \text{MovieGenre} \times \text{Genre})$

1
2

SQL \times DML \times SELECT \times Product(\times)

90

<u>Id</u>	Title	Language	RunningTime	<u>MovieId</u>	<u>GenreId</u>	<u>Id</u>	Title
1	2001: A Space Odyssey	English	142	1	1	1	Sci-fi
1	2001: A Space Odyssey	English	142	1	3	3	Adventure

σ (Movie \times MovieGenre \times Genre)
Title='2001: A Space Odyssey' AND
Movie.Id=MovieId AND
Genre.Id=GenreId

SQL × DML × **SELECT** × Product(×)

91

<u>Id</u>	Title	Language	RunningTime	<u>MovieId</u>	<u>GenreId</u>	<u>Id</u>	Title
1	2001: A Space Odyssey	English	142	1	1	1	Sci-fi
1	2001: A Space Odyssey	English	142	1	3	3	Adventure

(Movie×MovieGenre×Genre)

FROM Movie, MovieGenre, Genre

SQL × DML × **SELECT** × Product(×)

91

<u>Id</u>	Title	Language	RunningTime	<u>MovieId</u>	<u>GenreId</u>	<u>Id</u>	Title
1	2001: A Space Odyssey	English	142	1	1	1	Sci-fi
1	2001: A Space Odyssey	English	142	1	3	3	Adventure

σ (Movie × MovieGenre × Genre)
Title='2001: A Space Odyssey' AND
Movie.Id=MovieId AND
Genre.Id=GenreId

FROM Movie, MovieGenre, Genre
WHERE Movie.Id = MovieId AND
Title = '2001: A Space Odyssey' AND
Genre.Id = GenreId

SQL × DML × **SELECT** × Product(×)

91

Id	Title	Language	RunningTime	MovieId	GenreId	Id	Title
1	2001: A Space Odyssey	English	142	1	1	1	Sci-fi
1	2001: A Space Odyssey	English	142	1	3	3	Adventure

σ (Movie × MovieGenre × Genre)
Title='2001: A Space Odyssey' AND
Movie.Id=MovieId AND
Genre.Id=GenreId

SELECT * Title, Genre
FROM Movie, MovieGenre, Genre
WHERE Movie.Id = MovieId AND
Title = '2001: A Space Odyssey' AND
Genre.Id = GenreId

SQL × DML × **SELECT** × Product(×)

92

SELECT *
FROM Movie, MovieGenre, Genre
WHERE Movie.Id = MovieId **AND**
 Title = '2001: A Space Odyssey' **AND**
 Genre.Id = GenreId

Or

③ **SELECT** * M.Id, M. ⇒ **SELECT** M.Id **AS** MovieId
① **FROM** Movie **AS** M, MovieGenre **AS** MG, Genre **AS** G
② **WHERE** M.Id = MG.MovieId **AND**
 M.Title = '2001: A Space Odyssey' **AND**
 G.Id = MG.GenreId

SQL × DML × **SELECT** × Product(×)

93

```
SELECT *  
FROM Movie AS M, MovieGenre AS MG, Genre AS G  
WHERE M.Id = MG.Movielid AND  
       G.Id = MG.Genrelid
```

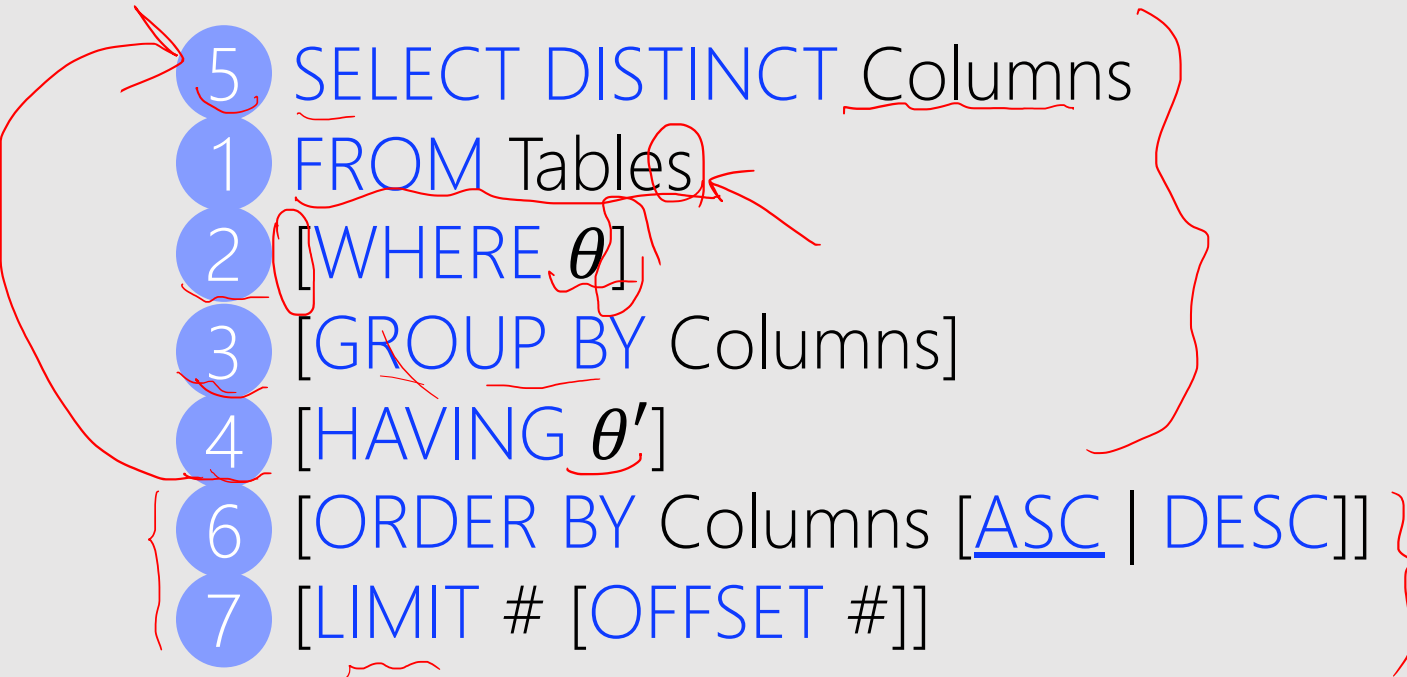
Movie
m5

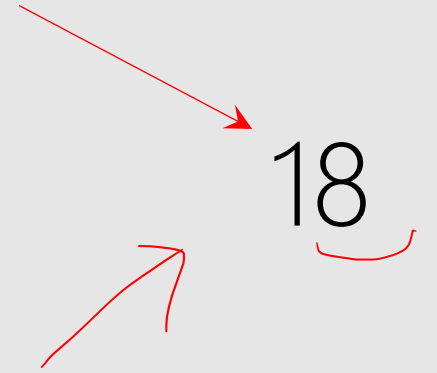
IMG

Genre
G10



Advanced SQL × **SELECT**

- 
- A diagram showing the components of an SQL SELECT statement. The components are listed vertically, each preceded by a blue circle containing a number. Red handwritten annotations include arrows and curly braces. A large red arrow points from the top left towards the first component. A red arrow points from the 'WHERE' clause to the 'FROM' clause. A red curly brace groups the 'ORDER BY' and 'LIMIT' clauses. Another red curly brace groups the 'WHERE', 'GROUP BY', and 'HAVING' clauses.
- 5 **SELECT DISTINCT** Columns
 - 1 **FROM** Tables
 - 2 [**WHERE** θ]
 - 3 [**GROUP BY** Columns]
 - 4 [**HAVING** θ']
 - 6 [**ORDER BY** Columns [ASC | DESC]]
 - 7 [**LIMIT** # [**OFFSET** #]]



18

Two red arrows point towards the number 18: one from the top left and one from the bottom left.

Advanced SQL × SELECT

19

- 2 SELECT Columns
- 1 FROM Table

Advanced SQL × SELECT

20

- 3 SELECT Columns
- 1 FROM Table
- 2 [WHERE θ]

Advanced SQL × DISTINCT

21

3 SELECT DISTINCT Columns ←
1 FROM Table
2 [WHERE θ]

To eliminate duplicate tuples, considering all columns.

Advanced SQL × DISTINCT

22

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

On what years at least one movie has been released?

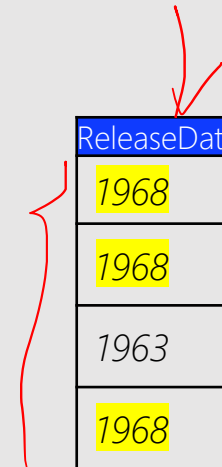
Advanced SQL × DISTINCT

23

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

On what years at least one movie has been released?

```
SELECT ReleaseDate  
FROM Movie
```



ReleaseDate
1968
1968
1963
1968

Advanced SQL × DISTINCT

24

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

In what years at least one movie has been released?

SELECT DISTINCT ReleaseDate
FROM Movie

① SELECT ReleaseDate FROM Movie
UNION
② SELECT ReleaseDate FROM Movie

ReleaseDate
1968
1963

Advanced SQL × DISTINCT

25

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

In what years at least one movie has been released?

SELECT DISTINCT ReleaseDate, Language
FROM Movie

ReleaseDate	Language
1968	English
1963	English
1968	EN

Advanced SQL × DISTINCT

26

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

What languages have been used in movies?

```
SELECT DISTINCT Language  
FROM Movie
```

Language
English
EN

Advanced SQL × Math Operation

27

3 **SELECT** Column {+, -, *, /, %, ...} Column | Constant
1 **FROM** Tables
2 [**WHERE** θ]

To apply a function on each value of a column.

Advanced SQL × Math Operation

28

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

List movies and their length in HH:MM?

```
SELECT Title,  
       RunningTime / 60 AS Hour,  
       RunningTime % 60 AS Minutes  
FROM Movie
```

Title	Hour	Minutes
2001: A Space Odyssey	2	22
Rosemary's Baby	NULL	NULL
The Birds	1	59
Planet of the Apes	1	52

Handwritten calculations and arrows:

- Red arrow from 142 in the first table to 142/60.
- Red arrow from 142/60 to 2 (Hour) and 22 (Minutes) in the second table.
- Red arrow from NULL in the first table to NULL in the second table.
- Red arrow from 119 in the first table to 119/60.
- Red arrow from 119/60 to 1 (Hour) and 59 (Minutes) in the second table.
- Red arrow from 112 in the first table to 112/60.
- Red arrow from 112/60 to 1 (Hour) and 52 (Minutes) in the second table.

Advanced SQL × Built-in Function

29

3 SELECT FUNCTION(Column), ...
1 FROM Tables
2 [WHERE θ]

To apply a function on each value of a column.

Advanced SQL × Built-in Function

30

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

List movies and their length in HH:MM?

SELECT Title, TIME(RunningTime * 60, 'unixepoch') AS Length
FROM Movie

Title	Length
2001: A Space Odyssey	2:22:00
Rosemary's Baby	NULL
The Birds	01:59:00
Planet of the Apes	01:52:00

Advanced SQL × Built-in Function

31

Refer to DBMS's manual for more built-in functions.

SQLite → https://www.sqlite.org/lang_corefunc.html

Advanced SQL × AGG Function

32

3 SELECT COUNT | SUM | MAX | MIN | AVG(Column)
1 FROM Tables
2 [WHERE θ]



To apply AGGregation functions on non-NULL values of one column and return a single value.

Advanced SQL × COUNT

33

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey 1	English	1968	142
2	Rosemary's Baby 2	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes 3	EN	1968	112

How many movies have been made in 1968?

```
SELECT COUNT(Title) AS MovieCount
FROM Movie
WHERE ReleaseDate = 1968
```

MovieCount
3

Advanced SQL × COUNT

34

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English 1	1968	142
2	Rosemary's Baby	English 2	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN 3	1968	112

How many movies have been made in 1968?

```
SELECT COUNT(Language) AS MovieCount
FROM Movie
WHERE ReleaseDate = 1968
```

MovieCount
3

Advanced SQL × COUNT

35

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

How many movies have been made in 1968?

```
SELECT COUNT(RunningTime) AS MovieCount
FROM Movie
WHERE ReleaseDate = 1968
```

MovieCount
2

Advanced SQL × COUNT

36

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

How many movies have been made in 1968?

Id
SELECT COUNT(*) AS MovieCount
FROM Movie
WHERE ReleaseDate = 1968

MovieCount
3

Advanced SQL × AVG

37

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

On average, what's the length of movies have been made in 1968?

SELECT AVG(RunningTime) AS AveMovieLength
FROM Movie
WHERE ReleaseDate = 1968

AveMovieLength
127

$$\frac{142 + 112}{2} = 127$$

Advanced SQL × MIN

38

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

What's the shortest length of movies have been made in 1968?



```
SELECT MIN(RunningTime) AS MinMovieLength
FROM Movie
WHERE ReleaseDate = 1968
```

MinMovieLength
112

Advanced SQL × MAX

39

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

What's the longest length of movies have been made in 1968?

```
SELECT MAX(RunningTime) AS MaxMovieLength
FROM Movie
WHERE ReleaseDate = 1968
```

MaxMovieLength
142

Advanced SQL × SUM

40

Advanced SQL × AGG Function

41

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

What's the shortest, longest, and average length of movies have been made in 1968?

Handwritten notes: title, Language, ReleaseDate, title

```
SELECT MIN(RunningTime) AS Min,  
       MAX(RunningTime) AS Max,  
       AVG(RunningTime) AS Avg,  
       SUM(RunningTime) AS Sum,  
       COUNT(RunningTime) AS Count,  
       COUNT(*)
```

FROM Movie

WHERE ReleaseDate = 1968

Min	Max	Avg	Sum	Count	Count(*)
112	142	127	254	2	3

Handwritten calculations: 127 (112 + 142) / 2, 254 (112 + 142)

Advanced SQL × AGG × DISTINCT

42

3 SELECT COUNT | SUM | MAX | MIN | AVG(DISTINCT Column)
1 FROM Tables
2 [WHERE θ]

To apply AGG functions on non-NULL values of one column,
after removing duplicates, and return a single value.

Advanced SQL × AGG × DISTINCT

43

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

How many different languages have been used in movies?

```
SELECT COUNT(DISTINCT Language) AS Count  
FROM Movie
```

Count
2

Advanced SQL × AGG × Math

44

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

What's the longest movie in hour which have been made in 1968?

```
SELECT MAX(RunningTime / 60) AS Max,  
FROM Movie  
WHERE ReleaseDate = 1968
```

Max
2

Advanced SQL × AGG × Built-in

45

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963 2022	119
4	Planet of the Apes	EN	1968	112

How many years old is the oldest movie?

```
SELECT MAX(STRFTIME('%Y', 'now') - ReleaseDate) AS Result
FROM Movie
WHERE ReleaseDate = 1968
```

Result
56

59

2022, 11, 8

Advanced SQL × WHERE

46

- 3 SELECT Columns
- 1 FROM Tables
- 2 [WHERE θ]

Advanced SQL × WHERE × Math

47

Advanced SQL × WHERE × Built-in

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

List all movies which are older than 55 years?

SELECT * FROM Movie

WHERE STRFTIME('%Y', 'now') - ReleaseDate > 55

Advanced SQL × WHERE × AGG

48

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

What are the longest movies which have been made in 1968?

```
SELECT *  
FROM Movie  
WHERE ReleaseDate = 1968 AND  
RunningTime = MAX(RunningTime)
```

SELECT Max(RT) FROM
Movie



Advanced SQL × WHERE × ~~AGG~~

49

Movie				
Id	Title	Language	ReleaseDate	RunningTime
1	2001: A Space Odyssey	English	1968	142
2	Rosemary's Baby	English	1968	NULL
3	The Birds	English	1963	119
4	Planet of the Apes	EN	1968	112

What is the oldest movie?

```
SELECT *  
FROM Movie  
WHERE ReleaseDate = MIN(ReleaseDate)
```

