* Chapter 4 : Relational Algebra

29 - 9 - 2018

Assume we have three Relations [1]

1st Sailors (sid : int , Sname : string , Rating : int , age : int)

قارب 2nd Boats (bid : int , bname : string , color : string)

3rd Reserve (bid : int , sid : int , day : date) ← Schema

Key

Sailors

sid	Sname	Rating	age
28	Yuppy	9	35
31	Lubber	8	55
44	grumpy	5	35
58	Rusty	10	35

Select

$\sigma_{<condition>}$ (Relation name) — New Relation

$\sigma_{age>35}$ (Sailors)

Sid	sname	Rating	age
31	Lubber	8	55

output

مش رليشن جديدة ⇐

New Relation In output

2

$\sigma_{1=1}$ (Sailors)

Condition = True كلشي صح

$\sigma_{sid > 31}$ (Sailors)

sid	Sname	rating	age
44	...	...	...
58	...	...	...

$\sigma_{sid > 31 \wedge rating > 6}$
and

sid	sname	rating	age
58	Rusty ..	10	31

$\wedge$: and
$\vee$: or

Note :- Conditions : used to determines tuples (Row)

* New operator called [PROJECT]

PROJECT [$\pi_{\text{<columns list>}}$ (relation name)] New Relation

π_{sname} (sailors) ⇒

sname
Yuppy
Lubber
guppy
Rusty

assume we add the following row
⇒ 59 bubber 7 38

after add the row
if we use Π ... :- We will not see another Lubbers

because it's gives us the distinic tuples [3]
(الختلف)
ما بتكتب المكرر

distinic tuples ← $\Pi_{sname, age}$ (Sailors)

Sname	age
Yuppy	35
Lubber	55
guppy	35
Rusty	35
lubber	35

Ex How To Mix between Vertical & Horizontal ?

Ex find the name of Sailors with age >35 (condition)

Ans
Variables → $W = \sigma_{age>35}$ (Sailors)

$\Pi_{sname}(W)$

⇒ output is the name of sailor with age >35 ⇒ Sname Lubber

OR $\Pi_{sname} [\sigma_{age>35} (sailors)]$

We can put any # of conditions &

If we have more than one Relation Rel. ↓ 4

$W = \sigma(Sailors)$ Same $\rho(S \leftarrow Sailors)$ Labels

Sailors.age > 35 ← $\rho(S \rightarrow Sailors)$

$\sigma_{S.age > 35}(S)$

S_1 = Sailors

sid	sname	rating	age
28	Yuppy	9	35
31	Lubber	8	55
44	Grampy	5	35
58	Rusty	10	35
59	Lubber	7	38

S_2

sid	sname	rating	age
28	Yuppy	9	35
66	Ahmad	9	55

Union $S_1 \cup S_2$ ⇒ 6 tuples ⇒ Yuppy مرتين

Intersection $S_1 \cap S_2$ ⇒ 1 tuple

Set difference $S_1 - S_2$ Every thing is in S_1 and not exist in S_2

→

sid
31
44
58
59

∪ , ∩ and − Work if ?

1- Same # (No. Number) of Columns [5]

2- Same order of datatype

Reserve

B

S.id	b.d	day
28	5	1/1/2018
28	6	1/2/2018

$S_2 \times B$ (↓ Cartesian Product)

$A = \{a, b\}$

$B = \{1, 2\}$

$\Rightarrow A \times B = \{(a,1), (a,2), (b,1), (b,2)\}$

	S.id	S.name	rat.g	age	s.id′	b.d	date
serve ✓	(28)	Yuppy	9	35	(28)	5	1/1/18
✓	(28)	Yuppy	9	35	(28)	6	1/2/2018
×	(66)	Ah.	9	55	(28)	5	1/1/18
×	(66)	Ah.	9	55	(28)	6	1/2/18

$\sigma(S_2 \times B)$

$S_2.sid' = B.sid$

10-10-2018

σ Select ⇒ from tuples

Π Project ⇒ from Column

ρ Rename (Sailors → S)

$\cup$

$\cap$

$-$: Works on row only ⇒ Ex $A = \{1, 2, 3\}$ $B = \{1, 2\}$ $A - B = A$ ✓ $A - B \neq \{3\}$?

Columns

$\sim\sim$

X Cartesian Product $\bowtie$

Sailors (sid , sname , age , rating)

Reserve (sid, bid, day)

Boats (bid , bname , colour)

Assume Sailors

sid	name	age	rating
1	AB	22	9
2	Ac	23	7
3	AD	18	6

Reserve

sid	bid	day
1	103	Mon
1	105	Tue
2	103	Fri

Cartesian Product

	Sid	name	age	rating	sid′	bid	day
✓	1	AB	22	9	1	103	Mon
✓	1	AB	22	9	1	105	Tue
×	1	AB	22	9	2	103	Fri
×	2	Ac	23	7	1	103	Mon
×	2	Ac	23	7	1	105	Tue
✓	2	Ac	23	7	2	103	Fri
×	3	AD	18	6	1	103	Mon
×	3	AD	18	6	1	105	Tue
×	3	AD	18	6	2	103	Fri

ρ (Sailors → S)

ρ (Reserve → R
Sid → Sid')

$\Pi_{\text{all-S.sid}}\left[\sigma_{S.sid = s.s.d'}\,(S \times R)\right]$

Condition

جميع الأعمدة ما عدا sid تصبح متشابه

Natural join ⇒ $S \bowtie R$ (join)
Primary Key Foreign Key
Operator

$S \bowtie R$ equi join
Sage = R

تتغير الكوندشن بدل FK، PK

⇒ Other condition with join

سؤال Query : List the name of Person who reserve Boat ?

Use natural joint

$\Pi_{\text{S.name}}(S \bowtie R)$ Result ⇒ AB, Ac

Project التكرار ما بطبع في

أسماء الأشخاص اللي حجزوا وعمرهم فوق 22

$\Pi_{\text{S.name}}(S \bowtie R)\ \sigma_{\text{S.age}>22}$

خطأ $\sigma_{S.age>22}\left[\pi_{S.sname}(S \bowtie R)\right]$ X

③

لأنه عمل Project قبل name بس

$\pi_{S.sname}\left[\sigma_{S.age>22}(S \bowtie R)\right]$ ✓

The Previous is join between 2 tables

سؤال: أسماء الأشخاص إلي حجزوا قارب أحمر

ملاحظة: Sail تقبل R

Boats تقبل R

S لا تقبل B دون R

$\pi_{S.sname}\left[S \bowtie \left[R \bowtie \sigma_{B.color=red}(B)\right]\right] \equiv \pi_{S.name}\left[\sigma\left[S \bowtie (R \bowtie B)\right]\right]$!

على أكثر

Note: join is double loop on 2 tables
reduce # of data then join

سؤال: أسماء القوارب إلي حجزهم أحمد

$\pi_{B.name}\left[\sigma_{S.name="Ahmad"}(S) \bowtie R\right]$ X

بده أسماء القوارب وهي ما دخلت بالعلاقة

Ans $\pi_{B.name}\left[\sigma_{S.name='Ahmad'}\left[B \bowtie (R \bowtie S)\right]\right] \equiv \pi\left[B \bowtie (R \bowtie \sigma_{=Ahmad}(S))\right]$

لا دخلها

أحسن Push down قبل join

(4)

سؤال

الأشخاص إلي حجزوا قارب أحمر أو أخضر

حل

$\pi_{S.sname} \left[\sigma_{B.color = 'red' \vee \ldots\ green} [S \infty (R \infty B)] \right]$

$\pi_{S.name} (S \infty (R \infty \sigma_{red \vee green} (B)))$

أو

red ∨ green

∩ تقاطع

∧ and

You can use intersect

سؤال

الأشخاص إلي حجزوا ع الأقل قاربين id

← ما في كلام ع الأقل

$\sigma_{S.id = S.id' \wedge bid > bid'} (R \times R')$

هالمرة ضرب Reserve

← نستعمل 2 copy

أكبر ✓

أصغر ✓

	sid	bid	day	sid'	bid'	day'
×	1	103	Mon	1	103	Mon
✓	1	103	Mon	1	105	Tue
×	1	103	Mon	2	103	Fri

(5)

سؤال

id الاشخاص الي ما حجزوا ولا قارب

$\pi_{sid}(S) - \pi_{sid}(R)$ ⇐

اسمائهم: $\pi_{Name}\left(\left(\pi_{sid}(S) - \pi_{sid}(R)\right) \bowtie S\right)$ (أسمائهم)

Same person ⇒ sid = sid'
More than one ⇒ bid >< bid'

Solve Ex 3.4 from Text Book

* The following shows RXR under condition <>

	sid	bid	day	sid'	bid'	day'
×	1	103	Mon	1	103	Mon
✓	1	103	Mon	1	105	Tue
×	1	103	Mon	2	103	Fri
✓	1	105	Tue	1	103	Mon
×	1	105	Tue	1	105	Tue
×	1	105	Tue	2	103	Fri
×	2	103	Fri	1	103	Mon
×	2	103	Fri	1	105	Tue
×	2	103	Fri	2	103	Fri

X : Same bid ⇒ one Boat ⇒ Not Need

X : Different Person

R:

sid	bid	day
1	103	Mon
1	105	Tue
2	103	Fri

X (Cartesian Product)

R':

sid'	bid'	day'
1	103	Mon
1	105	Tue
2	103	Fri

Review

13-10-2018

Sailors (sid , sname , rating , age)

Boats (bid , bname , color)

Reserve (sid , bid , day)

σ

π

$\times \Rightarrow \bowtie$ (join) عشان اجمع اكثر من table

$\cup$

$\cap$

$-$

ρ

أحمر أو أخضر $\sigma_{B.color = 'red'} (S \bowtie R \bowtie B) \cup \sigma_{B.color = 'green'} (S \bowtie R \bowtie B)$

V use it

$\wedge$ don't use it

سؤال :- أسماء الأشخاص اللي حجزوا قاربين

sid	bid	day
1	103	Mon
1	105	Tue
2	107	Wed

	sid	bid	day	sid	bid	day
✗	1	103	Mon	1	103	Mon
	1	105	Tue	1	103	Mon
✗	2	107	Wed	1	103	Mon
	1	103	Mon	1	105	Tue
✗	1	105	Tue	1	105	Tue
✗	2	107	Wed	1	105	Tue
✗	1	103	Mon	2	107	Wed
✗	1	105	Tue	2	107	Wed
✗	2	107	Wed	2	107	Wed

$$\underset{R.bid <> R'.bid'}{\sim} \left[\underset{R.sid = R.sid'}{\sim} \mid R \times \rho(R \rightarrow R') \right]$$

Query

(2)

قارب واحد

اكبر أو أصغر

Sol. $\underset{R.bid < R'.bid'}{\sim} [\quad ...... \quad ...... \quad]$

م : من أول وحدة X
ح : من ثاني وحدة x

Assume we want to find id for Persons who doesn't reserve any Boat

"Non-Monotonic Query"

بنطلع عشان نوجد النتيجة

$\pi_{sid}(S) - \pi_{sid}(R)$ [compatable, Both have sid]

In this chapter ~~...~~ only we want [Relational Algebra]

Logic x

Typle calc x

Division x

Exercise :- 4 [From Text Book]

$$\pi_{sname}\left(\pi_{s.id}\left[\left(\sigma_{color='red'} Parts\right) \bowtie \left(\sigma_{cost<100} catalog\right)\right] \bowtie suppliers\right)$$

Suppliers (sid , sname , add)

Parts (Pid , Pname , Color)

Catalog (sid , pid , cost)

What does this query do ?

Part ③ $\pi_{sname}\left(\left(\sigma_{color='red'} Parts\right) \bowtie \left(\sigma_{cost<100} catalog\right) \bowtie supplier\right)$

$\cap$

$\pi_{snam}\left(\left(\sigma_{color='green'} Parts\right) \cdots\right.$

Ex R = n tuples

S = m tuples

Find Maximum tuples R x S ⇒ m x n

R ⋈ S ⇒ min (n, m)

(4)

④ same but sid

⑤ $\pi_{sname} \left(\pi_{sid, sname} \left[\ldots \right] \right)$

Natural Join :

تضربهم

فرضاً 3, 5

3 x 5 = 15

sid	,	,
1		
2		
3		

sid	bid	day
1	103	Mon
1	105	Tue
2	107	Wed

	sid	,	,	sid′	bid′
	1			1	103
x	1			1	105
x	1			2	107
x	2			1	103
x	2			1	105
	2			2	107
x	3			1	103
x	3			1	105
x	3			2	107

حل 3 ⇐ min ✓

لو في P.K , F.K تختلف