# RELATIONAL ALGEBRA THE DIVISION OPERATION

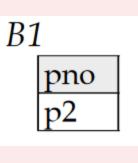
- ▶ Is an **extended operation** of the relational algebra.
- Extended operators are those operators which can be derived from basic operators.
- ▶ There are mainly three types of extended operators in Relational Algebra:
  - Join
  - **▶** Intersection
  - Divide

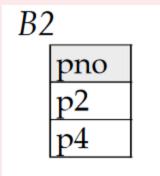
- ▶ Division operator  $\mathbf{A} \div \mathbf{B}$  or  $\mathbf{A}/\mathbf{B}$  can be applied if and only if:
  - ▶ Attributes of B is proper subset of Attributes of A.
- ▶ Useful for expressing queries that include a "for all" or "for every" phrase.
- ► Some instances where division operator is used are:
  - ▶ Which person has account in all the banks of a particular city?
  - ▶ Which students have taken all the courses required to graduate?

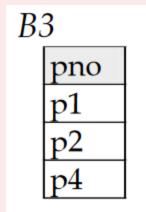
- ▶ "Which persons have a loyal customer's card at ALL the clothing boutiques in town X?"
- ▶ "Which persons have a bank account at ALL the banks in the country?"
- ▶ "Which students are registered on ALL the courses given by Soini?"
- ▶ "Which students are registered on ALL the courses that are taught in period 1?"
- ▶ "Which boys are registered on those courses that are taken by ALL the girls?"
- ▶ "Which girls are registered on ALL the courses taken by student nr. 40101?

- ► The relation returned by division operator will have attributes = (All attributes of A All Attributes of B)
- The relation returned by division operator will return those tuples from relation A which are associated to every B's tuple.
- ► Important: Most RDBMS implementations with SQL as the primary query language do not directly implement division. However, it can be represented using other operations.(like cross join, Except, In )

A		
	sno	pno
	s1	p1
	s1	p2
	s1	p3
	s1	p4
	s2	p1
	s2	p2
	s3	p2
	s4	p2
	s4	p4



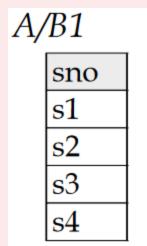


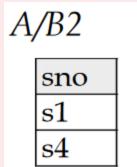


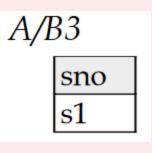
To apply division operator as

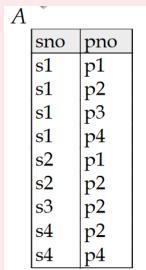
A/B1; A/B2; A/B3

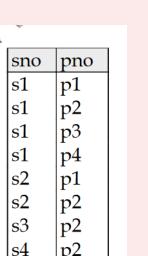
- ► Are the operation valid?
- ▶ Yes B1, B2 and B3 are proper subset of attributes in A.

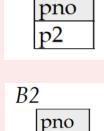






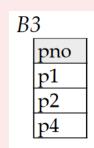






p2

B1



#### **SQL Implementation of Division**

Given two relations (tables): R(x,y), S(y).

R and S: tables

**x and y**: column of R

y : column of S

 $\mathbf{R}(\mathbf{x},\mathbf{y}) \div \mathbf{S}(\mathbf{y})$  means gives all distinct values of x from R that are associated with all values of y in S.

**Computation of Division**:  $R(x,y) \div S(y)$ 

#### **Steps:**

- 1) Find out all possible combinations of S(y) with R(x) by computing R(x) x(cross join) S(y), say r1
- 2) Subtract actual R(x,y) from r1, say r2
- 3) x in r2 are those that are not associated with every value in S(y); therefore R(x)-r2(x) gives us x that are associated with all values in S(y)

#### Division $R \div S$

– Defines a relation over the attributes C that consists of set of tuples from R that match combination of every tuple in S.

• Expressed using basic operations:

$$\mathrm{T1} \leftarrow \mathrm{\Pi c}(\mathrm{R})$$

$$T2 \leftarrow \Pi c((S X T1) - R)$$

$$T \leftarrow T1 - T2$$

Consider the following schema:

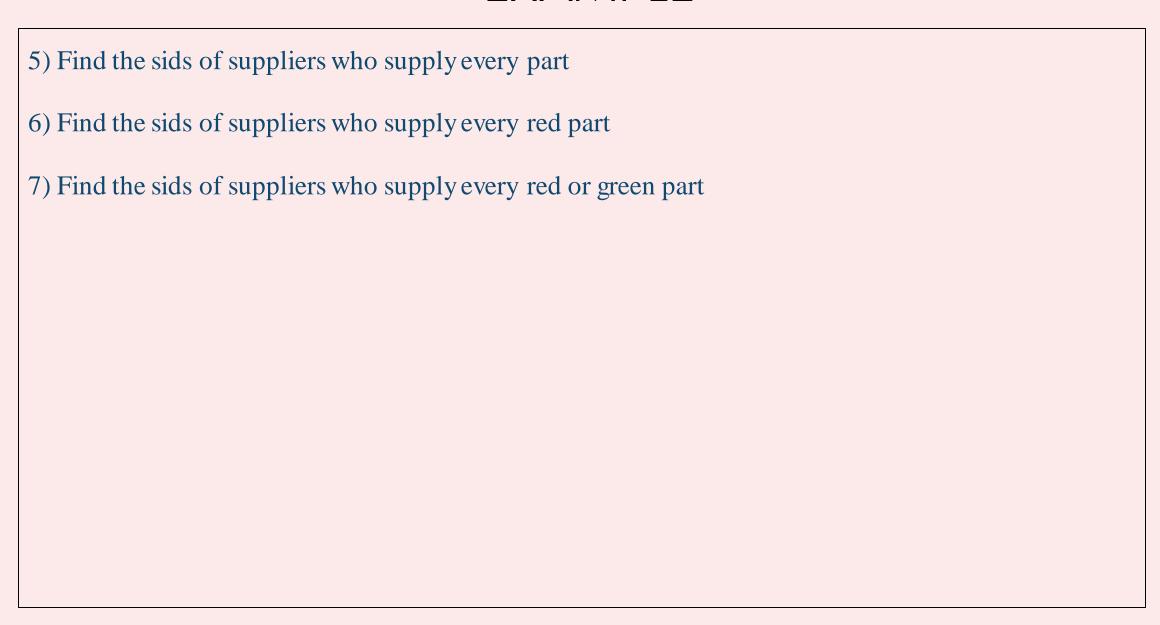
Suppliers (sid: integer, sname: string, address: string)

Parts (pid: integer, pname: string, color: string)

Catalog (sid: integer, pid: integer, cost: real)

The key fields are underlined and domain of each field is listed after the field name.

- 1) Find the name of suppliers who supply some red parts
- 2)Find the sids of suppliers who supply some red or green parts
- 3) Find the sids of suppliers who supply some red part or are at 221 packer Ave
- 4) Find the sids of suppliers who supply some red part and some green part



1) Find the name of suppliers who supply some red parts We first find the pids of parts that are red in color and then we compute the natural join of this with catalog from this we project sid which gives ids of the supplier who supply some red part, then we take the natural join of this with supplier and project names which gives us the names of suppliers who supply some red part

Step 1 :  $R1 = \pi pid(\sigma color = 'red'parts)$ 

Step 2 :  $R2 = \pi sid(R1 \$ Catalog)$ 

Step 3 :  $R3 = \pi name(R2 \$ Sppliers)$ 

Required answer is R3

2) Find the sids of suppliers who supply some red or green parts

Step1:  $R1 = \pi pid(\sigma color = 'red' V 'green' parts)$ 

Step 2 :  $R2 = \pi sid(R1 \$ Catalog)$ 

Same as above one but here we have to choose red or green parts and we have to have sids of suppliers so we can stop after step 2 after choosing parts either in red color or green color

3) Find the sids of suppliers who supply some red part or are at 221 packer Ave Sids of suppliers who supply some red part

Step 1 : R1 =  $\pi$ pid( $\sigma$ color = 'red'parts)

Step 2 :  $R2 = \pi sid(R1 \$ Catalog)$ 

Sids of suppiers who are at 221 packer Ave

Step 1 :  $R3 = \pi sid\sigma address = '221 packer Ave(Suppliers)$ 

Therefore sids of suppliers who supply some red part or are at 221 packer Ave Is R2 U R3

- 4) Find the sids of suppliers who supply some red part and some green part
- A)  $R1 = \pi sid(\pi pid(\sigma color = 'red' parts)$ \$ Catalog)
  - $R2 = \pi sid(\pi pid(\sigma color = 'green' parts)$ \$ Catalog)

From question one we get the sids of suppliers who supply some red part (R1) Similarly R2 is the sids of suppliers who supply some green part

Required list of sids who supply some red and some green part is R1 Intersection R2

5) Find the sids of suppliers who supply every part

A)  $R1=\pi \text{sid}$ , pid Catalog

R2=πpidParts

Suppliers (sid: integer, sname: string, address: string)

Parts (pid: integer, pname: string, color: string)

Catalog (sid: integer, pid: integer, cost: real)

R1/R2 give us the required list of sids of suppliers who supply every part

6)Find the sids of suppliers who supply every red part

This is same as previous one but in R2 we consider only red parts

 $R1 = \pi \text{sid}$ , pid Catalog

R2=πpidσcolr='red'parts

So required answer is R1/R2

- 7) Find the sids of suppliers who supply every red or green part
- A)  $R1 = \pi sid$ , pid Catalog

R2=πpidσcolr='red' v 'green' Parts

R1/R2 gives the sids of suppliers who supply every part which is either red in Color or green in color