RELATIONAL ALGEBRA

THE DIVISION OPERATION

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 OPERATION

- Division operator **A÷B or A/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?

DIVISION OPERATION

- “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?

DIVISION OPERATION

- 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)**

DIVISION OPERATION

A

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

B1

pno
p2

B2

pno
p2
p4

B3

pno
p1
p2
p4

To apply division operator as

A/B1 ; A/B2 ; A/B3

DIVISION OPERATION

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

A/B1

sno
s1
s2
s3
s4

A/B2

sno
s1
s4

A/B3

sno
s1

A

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

B1

pno
p2

B2

pno
p2
p4

B3

pno
p1
p2
p4

DIVISION OPERATION

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

R(x,y) ÷ S(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) ÷ 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

DIVISION OPERATION

Division R ÷ 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:

$T1 \leftarrow \Pi_C(R)$

$T2 \leftarrow \Pi_C((S \times T1) - R)$

$T \leftarrow T1 - T2$

EXAMPLE

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

EXAMPLE

5) Find the sids of suppliers who supply every part

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

7) Find the sids of suppliers who supply every red or green part

EXAMPLE

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 = πpid(σcolor = ‘red’parts)

Step 2 : R2 = πsid(R1 $ Catalog)

Step 3 : R3=πname(R2 $ Sppliers)

Required answer is R3

EXAMPLE

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

Step1: R1 = πpid(σcolor = ‘red’ V ‘green’parts)

Step 2 : R2 = πsid(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

EXAMPLE

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 = πpid(σcolor = ‘red’parts)

Step 2 : R2 = πsid(R1 $ Catalog)

Sids of suppiers who are at 221 packer Ave

Step 1 : R3 = πsidσaddress = ‘221 packer Ave(Suppliers)

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

EXAMPLE

4) Find the sids of suppliers who supply some red part and some green part

A) R1 = πsid(πpid(σcolor = ‘red’ parts) $ Catalog)

R2 = πsid(πpid(σcolor = ‘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

EXAMPLE

5) Find the sids of suppliers who supply every part

Suppliers (sid : integer, sname : string, address : string)
Parts (pid : integer, pname : string, color : string)
Catalog (sid : integer, pid : integer, cost : real)

A) R1=πsid,pid Catalog

R2=πpidParts

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= πsid,pid Catalog

R2=πpidσcolr=’red’parts

So required answer is R1/R2

EXAMPLE

7)Find the sids of suppliers who supply every red or green part

A) R1= πsid,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