# COMPUTER SCIENCE

## Database Management System

### Query Language



Lecture_4

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TOPICS TO BE COVERED

01 Basic Operators

02 Derived Operators

Selection [$\sigma$]

Projection [$\pi$]

Union [$\cup$]

Intersection [$\cap$]

Minus | Set Difference | EXCEPT [$-$]

CROSS Product

Rename

JOIN

Natural Join

Conditional Join

Equi Join

LOJ ($⟕$)

ROJ ($⟖$)

FULL OUTER JOIN. ($⟗$)

$\dot{⋈}$

# Relational Algebra

## Basic operators

- $\pi$ : Projection operator
- $\sigma$ : Selection operator
- $\times$ : Cross-product operator
- U : Union
- – : Set difference
- $\varrho$ : Rename operator

# Relational Algebra

## Derived operators

$\cap$ : Intersection {using "_"}

$\bowtie$ : Join {using X, $\sigma$}

/ or $\div$ : Division {using $\pi$, x, –}

Q.

Let R and S be two relations with the following schema

R(P, Q, R1, R2, R3)

S(P, Q, S1, S2)

Where {P, Q} is the key for both schemas. Which of the following queries are equivalent?

I. $\pi_P (R \bowtie S)$

II. $\pi_P(R) \bowtie \pi_P(S)$

III. $\pi_P(\pi_{P,Q} (R) \cap \pi_{P,Q}(S))$

IV. $\pi_P(\pi_{P,Q}(R) - (\pi_{P,Q} (R) - \pi_{P,Q} (S)))$

(A) Only I and II

(B) Only I and III

(C) Only I, II and III

(D) Only I, III and IV

Division operator [ / ] : It is Derived operator.

$$\frac{\pi_{AB}(R)}{\pi_{B}(S)} = \text{Quot.}(\underline{A})$$

## Division

- It is used to retrieve attribute value of R which has paired with every attribute value of other relation S.
- $\pi_{AB}(R)/\pi_B(S)$: It will retrieve values of attribute 'A' from R for which there must be pairing 'B' value for every 'B' of S.

$$\pi_{AB}(R) / \pi_B(S)$$ : A → Pair with Every Value of 'B'.

# Expansion of '/' by using basic operator

- Example: Retrieve sid's who enrolled every course.
- Result:

  $\pi_{sidcid}(\text{Enroll}) / \pi_{cid}(\text{Course})$

  Step 1: Sid's not enrolled every course of course relation.

  (Sid's enrolled proper subset of course)

  $\pi_{sid}((\pi_{sid}(\text{Enroll}) \times \pi_{cid}(\text{course})) - \pi_{sidcid}(\text{Enroll}))$
- Step 2:

  [sid's enrolled every course] = [sid's enrolled some course] – [sid's not enrolled every course]

$\therefore \quad \pi_{sidcid}(E) / \pi_{cid}(c) = \pi_{sid}(E) - \pi_{sid}((\pi_{sid}(E) \times \pi_{cid}(C) - \pi_{sidcid}(E))$

# Division

**Q. 1** Retrieve all student who are Enrolled **Some course** or **Any course** or at least one course?

**Solution** $\boxed{\Pi_{Sid}(\text{Enrolled})}$

| Sid |
|---|
| $S_1$ |
| $S_2$ |
| $S_3$ |

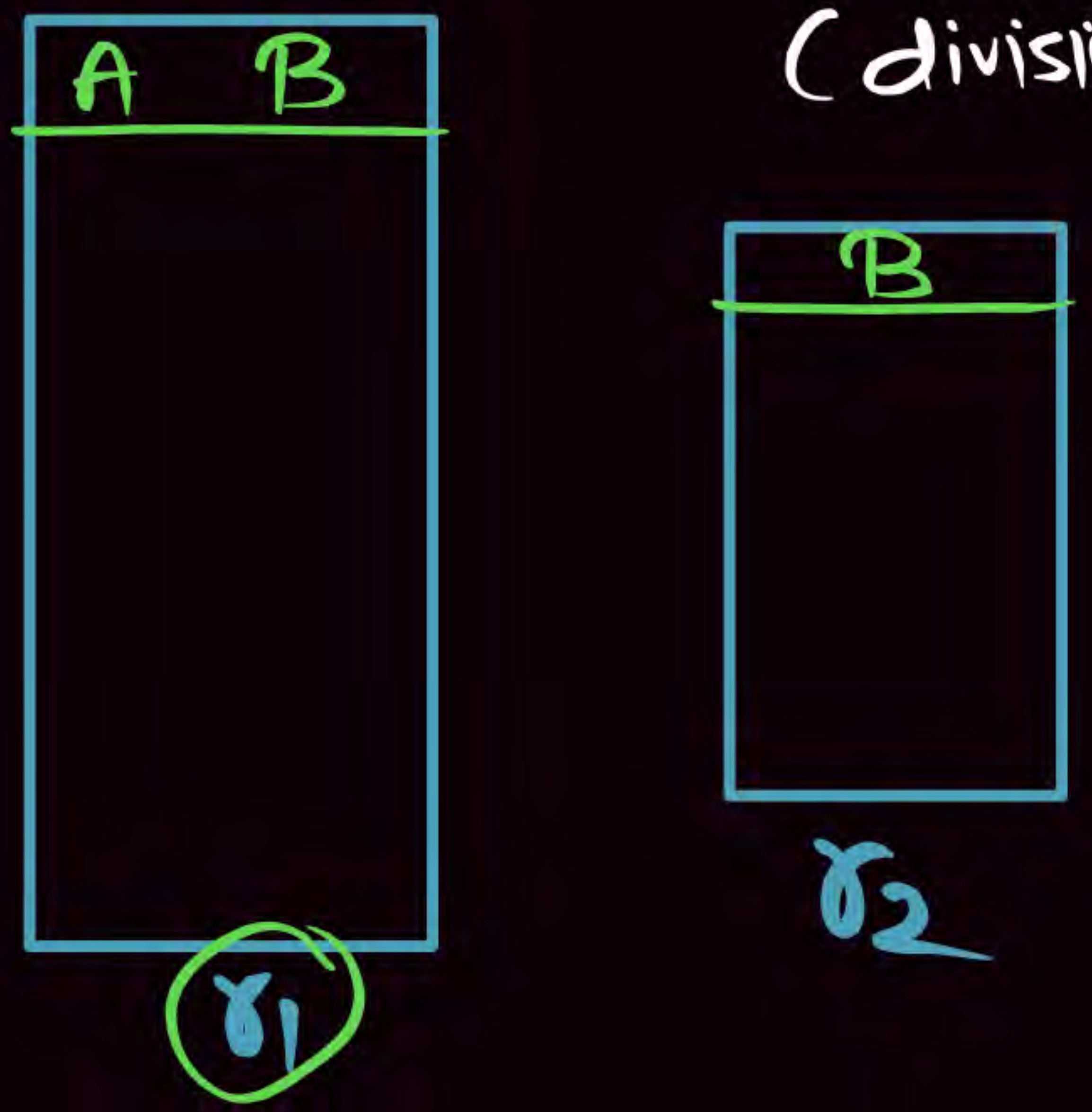
**Enrolled**

| Sid | Cid |
|---|---|
| $S_1$ | $C_1$ |
| $S_1$ | $C_2$ |
| $S_1$ | $C_3$ |
| $S_2$ | $C_1$ |
| $S_2$ | $C_3$ |
| $S_3$ | $C_1$ |

**Course**

| Cid |
|---|
| $C_1$ |
| $C_2$ |
| $C_3$ |

# Division




$$\frac{(\text{Dividedend})\ r_1}{(\text{divisior})\ r_2} = x$$

Quotient

$$\frac{\pi_{AB}(r_1)}{\pi_B(r_2)} = \text{Quotient}(A)$$

Value of 'A' which pair with Every value B of $r_2$

# Division [/]

$$\frac{\Pi_{AB}(R)}{\Pi_{B}(S)} = \text{Quot.}(\underline{A})$$

Getting Those value of 'A' Which Pair with Every Value of B of S in Relation R.

find Sid who enrolled

ALL Course

$\bowtie$

# Division

**Q.** Retrieve all student who are Enrolled every course?

**Solution**

$$\boxed{\Pi_{Sid,Cid}(\text{Enrolled}) / \Pi_{Cid}(\text{Course})}$$

Find

2nd attribute must be same.

$\boxed{S_1}$ Ans

**Enrolled**

| Sid | Cid |
|---|---|
| $S_1$ | $C_1$ |
| $S_1$ | $C_2$ |
| $S_1$ | $C_3$ |
| $S_2$ | $C_1$ |
| $S_2$ | $C_3$ |
| $S_3$ | $C_1$ |

**Course**

| Cid |
|---|
| $C_1$ |
| $C_2$ |
| $C_3$ |

$$\frac{\text{dividend}}{\text{divisior}} = \text{Quotient}$$

$$\frac{\pi_{sid,\,cid}(\text{Enrolled})}{\pi_{cid}(\text{Course})} = \text{Quot.}(\text{Sid})$$

Q) W.A.Q to Find Sid Who enrolled every Course ?

Q) W.A.Q to Find STUDENT Who attend every class ?

3 Student

3 class

# Division

**Q.** Retrieve all student who are Enrolled every course?

**Solution**

$\Pi_{Sid, Cid}$ (Enrolled) / $\Pi_{Cid}$ (Course)

Find

2nd attribute must be same.

$\boxed{S_1}$ Ans

| Enrolled | |
|---|---|
| Sid | Cid |
| $S_1$ | $C_1$ |
| $S_1$ | $C_2$ |
| $S_1$ | $C_3$ |
| $S_2$ | $C_1$ |
| $S_2$ | $C_3$ |
| $S_3$ | $C_1$ |

| Course |
|---|
| Cid |
| $C_1$ |
| $C_2$ |
| $C_3$ |

# Division

**Q.** Retrieve all student who are Enrolled every course?

E Enrolled

$C_1$
$C_2$
$C_3$

**Solution**

$E \div C_1$

step1

| Sid |
|---|
| $S_1$ |
| $S_2$ |
| $S_3$ |

step2

$E \div \begin{matrix} C_1 \\ C_2 \end{matrix}$

| |
|---|
| $S_1$ |

Step3

$E \div \begin{matrix} C_1 \\ C_2 \\ C_3 \end{matrix}$

| Sid |
|---|
| $S_1$ |

Ans

**Enrolled**

| Sid | Cid |
|---|---|
| $S_1$ | $C_1$ |
| $S_1$ | $C_2$ |
| $S_1$ | $C_3$ |
| $S_2$ | $C_1$ |
| $S_2$ | $C_3$ |
| $S_3$ | $C_1$ |

**Course**

| Cid |
|---|
| $C_1$ |
| $C_2$ |
| $C_3$ |

$$\frac{\pi_{sid,cid}(Enrolled)}{\pi_{cid}(Course)}$$

$$\pi_{sid}(Enrolled) - \underbrace{\pi_{sid}\left[\pi_{sid}(Enrolled) \times \pi_{cid}(Course) - Enrolled\right]}_{\Downarrow}$$

Not Enrolled every Course.

$$\pi_{sid}(Enrolled) - \pi_{sid}\left[\pi_{sid}(Enrolled) \times Course - Enrolled\right]$$

$$\Pi_{Sid}(Enrolled) - \Pi_{Sid}\left[\Pi_{Sid}(Enrolled) \times \Pi_{Cid}(Course) - Enrolled\right]$$

| Sid |
|---|
| $S_1$ |
| $S_2$ |
| $S_3$ |

$-$

| Sid |
|---|
| $S_2$ |
| $S_3$ |

| Sid |
|---|
| $S_1$ |
| $S_2$ |
| $S_3$ |

$\times$

| Cid |
|---|
| $C_1$ |
| $C_2$ |
| $C_3$ |

$\Rightarrow$

| Sid | Cid |
|---|---|
| $S_1$ | $C_1$ |
| $S_1$ | $C_2$ |
| $S_1$ | $C_3$ |
| $S_2$ | $C_1$ |
| $S_2$ | $C_2$ |
| $S_2$ | $C_3$ |
| $S_3$ | $C_1$ |
| $S_3$ | $C_2$ |
| $S_3$ | $C_3$ |

Universal Result
(Every Student Enrolled Every Course)

$-$

Enrolled

| Sid | Cid |
|---|---|
| $S_1$ | $C_1$ |
| $S_1$ | $C_2$ |
| $S_1$ | $C_3$ |
| $S_2$ | $C_1$ |
| $S_2$ | $C_3$ |
| $S_3$ | $C_1$ |

$\Rightarrow$

| Sid | Cid |
|---|---|
| $S_2$ | $C_2$ |
| $S_3$ | $C_2$ |
| $S_3$ | $C_3$ |

Student Which Not enrolled these Course

$\Downarrow \Pi_{Sid}$

| Sid |
|---|
| $S_2$ |
| $S_3$ |

Student Not Enrolled ALL Course.

| Sid |
|---|
| $S_1$ |

Ans

# Division [/]

$$\frac{\pi_{AB}(R)}{\pi_{B}(S)} = \text{Quot.}(A)$$

Getting Those Value of 'A' Which Pair with Every Value of B of S in Relation R.

# Division

$\Pi_{sid\,cid}(\text{Enrolled}) / \Pi_{cid}(\text{Course}) \Rightarrow$ Quotient (sid)

Sid who enrolled every Course.

OR

Sid which pair every Cid of Course.

$$\Pi_{\text{Sid}}(\text{Enrolled}) - \Pi_{\text{Sid}}[\Pi_{\text{Sid}}(\text{Enrolled}) \times \Pi_{\text{Cid}}(\text{Course}) - \text{Enrolled}]$$

$$\Pi_{AB}(R) / \Pi_B(S) = \Pi_A(R) - \Pi_A[\Pi_A(R) \times \underbrace{\Pi_B(S)}_{'S'} - R]$$

$\Downarrow$

Quotient (A)

Getting 'A' which pair with every value B of S in Relation R

OR

$$\Pi_A(R) - \Pi_A[\Pi_A(R) \times S - R]$$

$$\frac{\pi_{ABCD}(R)}{\pi_{CD}(S)} = \pi_{AB}(R) - \pi_{AB}\left[\pi_{AB}(R) \times \underbrace{\pi_{CD}(S)}_{S} - R\right]$$

# Division

$$\boxed{\Pi_{AB}(R) \,/\, \Pi_{B}(S) = \Pi_{A}(R) - \Pi_{A}\left[\Pi_{A}(R) \times \Pi_{B}(S) - R\right]}$$

Find Connection

$$\boxed{\Pi_{ABCD}(R) \,/\, \Pi_{CD}(S) \Rightarrow \Pi_{AB}(R) - \Pi_{AB}\left[\Pi_{AB}(R) \times \Pi_{CD}(S) - R\right]}$$

① $$\boxed{\frac{\pi_{AB}(R)}{\pi_B(S)} = \text{Quotient}(A)}$$

getting 'A' which Pair with Every B value of S in Relation R.

$$\boxed{\pi_A(R) - \pi_A\left[\pi_A(R) \times \underset{[S]}{\pi_B(S)} - R\right]}$$ Ans

OR

$$\boxed{\pi_A(R) - \pi_A\left[\pi_A(R) \times S - R\right]}$$

② $$\boxed{\frac{\pi_{AB}(R)}{\pi_A(S)} = \text{Quotient}(B)}$$

getting 'B' which Pair with Every A value of S in Relation R.

$$\boxed{\pi_B(R) - \pi_B\left[\pi_B(R) \times \underset{[S]}{\pi_A(S)} - R\right]}$$ Ans

Q.1

$$\frac{\Pi_{ABCD}(R)}{\Pi_{CD}(S)} = \text{Quotient}(AB)$$

getting AB which pair with every value of CD of S in Relation R

$$\Pi_{AB}(R) - \Pi_{AB}\left[\Pi_{AB}(R) \times \overset{\Pi_{CD}(S)}{S} - R\right]$$ Ans

Q.2

$$\frac{\Pi_{ABCD}(R)}{\Pi_{AB}(S)} = \text{Quotient}(CD)$$

getting CD which pair with every value of AB of S in Relation R

$$\Pi_{CD}(R) - \Pi_{CD}\left[\Pi_{CD}(R) \times \overset{\Pi_{AB}(S)}{S} - R\right]$$ Ans

**Q.**

Consider the following three relations in a relational database:

$\boxed{\text{Employee (eId, Name)}}$, $\boxed{\text{Brand (bId, bName)}}$, $\boxed{\text{Own(eId, bId)}}$ ✓

Which of the following relational algebra expressions return the set of eIds who own all the brands? **[GATE: 2022]**

(A) $\pi_{eId}\,(\pi_{eId,\,bId}\,(Own / \pi_{bId}\,(Brand))$

$\Pi_A(R) - \Pi_A\left[\Pi_A(R) \times \Pi_B(S) - R(\Pi_{AB}(R))\right]$

(B) $\pi_{eId}\,(Own) - \pi_{eId}\,((\pi_{eId}\,(Own) \times \pi_{bId}\,(Brand)) - \pi_{eId,\,bId}\,(Own))$

(C) $\pi_{eId}\,(\pi_{eId,\,bId}\,(Own) / \pi_{bId}\,(Own))$

(D) $\pi_{eId}\,((\pi_{eId}\,(Own) \times \pi_{bId}\,(Own) / \pi_{bId}\,(Brand))$

brand

| bid | bname |
|---|---|
| $b_1$ | AT |
| $b_2$ | WC |

own

| eid | bid |
|---|---|
| $e_1$ | $b_1$ |
| $e_1$ | $b_2$ |
| $e_2$ | $b_1$ |
| $e_3$ | $b_1$ |
| $e_3$ | $b_2$ |

Ans

| eid |
|---|
| $e_1$ |
| $e_3$ |

# Division operation

↳ Next Varient

Consider the two relation Suppliers and Parts are given below.

Suppliers

| $S_{no}$ | $P_{no}$ |
|---|---|
| $S_1$ | $P_1$ |
| $S_1$ | $P_2$ |
| $S_1$ | $P_3$ |
| $S_1$ | $P_4$ |
| $S_2$ | $P_1$ |
| $S_2$ | $P_2$ |
| $S_3$ | $P_2$ |
| $S_4$ | $P_2$ |
| $S_4$ | $P_4$ |

Parts

| $P_{no}$ |
|---|
| $P_2$ |
| $P_4$ |

$\pi_{S_{no} P_{no}}$ (Suppliers) / $\pi_{P_{no}}$ (Parts)

The number of tuples are there in the result when the above relational algebra query executes is _____.

$S \div P_2$

$S_1$
$S_2$
$S_3$
$S_4$

$S \div \begin{matrix} P_2 \\ P_4 \end{matrix}$

$S_1$
$S_4$

Q) $\Pi_{AB}(R) / \Pi_{B}(S)$ if R has m Tuple & S has n Tuple then what is Minimum & maximum # Tuples in the o/p ? (Assume R & S Both are Non Empty ?)

Sol$^n$

Minimum $= 0$

Maximum $= \left\lfloor \frac{m}{n} \right\rfloor$

R : 8 Tuples ✓

S: 3 Tuple $\begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix}$

$\left\lfloor \frac{8}{3} \right\rfloor = 2$ Ans.

Q) $\Pi_{AB}(R) / \Pi_B(S)$ if R has m Tuple & S has n Tuple then what is Minimum & maximum # Tuples in the o/p? (Assume R Non Empty & S is Empty.)

Soln Minimum : 1

Maximum : m

$$\Pi_{AB}(R) / \Pi_B(S) = \underline{\Pi_A(R)} - \Pi_A\left[\underbrace{\underbrace{\Pi_A(R) \times \underbrace{S}_{'0'}}_{'Empty'} - R}_{Empty(\phi)}\right]$$

$\Downarrow$

'm' Ans

sid

$\Pi_{sid}$

| sid | cid |
| --- | --- |
| $S_1$ | $c_1$ |
| $S_1$ | $c_2$ |

$S_1$

Consider the Database with relations:

S Supplier (Sid, Sname, Rating)

P Parts (Pid, Pname, Color)

S Catalog (Sid Pid, Cost)

Q. Find the Sid of Supplier whose Rating greater than 9?

Q.

Find the Pid of Red Color Parts?

Q. Retrieve Sid of Supplier who supplied some Red color parts?

Solution: $\Pi_{Sid}\left[\sigma_{\substack{P.Pid=C.Pid \\ P.Color=Red}} \wedge (\text{Catalog} \times \text{Parts})\right]$

**Note:** Let an Attribute A belongs to R only then

$\sigma_{A='a'}(R \bowtie S) = \sigma_{A='a'}(R) \bowtie S \rightarrow$ More efficiency query

**Note:** Let an Attribute A belongs to R only and Attribute B belongs to S only then

$\sigma_{A='a' \wedge B='b'}(R \bowtie S) = \sigma_{A='a'}(R) \bowtie \sigma_{B='b'}(S)$

Q.

Consider the following relation schemas:

b-Schema = (b-name, b-city, assets)

a-Schema = (a-num, b-name, bal)

d-Schema = (c-name, a-number)

Let branch, account and depositor be respectively instances of the above schemas. Assume that account and depositor relations are much bigger than the branch relation.

Consider the following query:

$$\Pi_{\text{c-name}} (\sigma_{\text{b-city} = \text{"agra"} \wedge \text{bal} < 0} (\text{branch} \bowtie \text{account} \bowtie \text{depositor}))$$

**Q.** Which one of the following queries is the most efficient version of the above query? [GATE-2007: 2 Marks]

(A) $\Pi_{c\text{-}name}\left(\sigma_{bal<0}\left(\sigma_{b\text{-}city=\text{"Agra"}}\text{ branch} \bowtie \text{account}\right) \bowtie \text{depositor}\right)$

(B) $\Pi_{c\text{-}name}\left(\sigma_{b\text{-}city=\text{"Agra"}}\text{ branch} \bowtie \left(\sigma_{bal<0=}\text{ account}\right) \bowtie \text{depositor}\right)$

(C) $\Pi_{c\text{-}name}\left(\sigma_{b\text{-}city=\text{"Agra"}}\text{ branch} \bowtie \sigma_{b\text{-}city=\text{"Agra} \wedge bal<0}\text{ account} \bowtie \text{depositor}\right)$

(D) $\Pi_{c\text{-}name}\left(\sigma_{b\text{-}city=\text{"Agra"}}\text{ branch} \bowtie\left(\sigma_{b\text{-}city=\text{"Agra} \wedge bal<0}\text{ account} \bowtie \text{depositor}\right)\right)$

**Q.**

Consider two relations $R_1(A, B)$ with the tuples (1, 5), (3, 7)and $R_2$ (A, C) = (1, 7)(4, 9)
Assume that R(A, B, C) is the full natural outer join of $R_1$ and $R_2$.
Consider the following tuples of the form (A, B, C); a = (1, 5, null), b = (1, null, 7), c = (3, null, 9), d = (4, 7, null), e = (1, 5, 7), f = (3, 7, null), g = (4, null, 9). Which one of the following statements is correct? [GATE-2015: 1 Mark]

(A) R contains a, b, e, f, g, but not c, d

(B) R contains all of a, b, c, d, e, f, g

(C) R contains e, f, g, but not a, b

(D) R contains e but not f, g

Q.

Consider the following relations given below:

R

| A | B |
|---|---|
| 6 | 6 |
| 7 | 6 |
| 8 | 8 |

S

| C | D |
|---|---|
| 6 | 7 |
| 8 | 9 |
| 8 | 10 |

$$\Pi_{AD}(R \times S) - P_{A \leftarrow B}(\Pi_{BD}(R \bowtie_{B=C} S))$$

Number of tuples return by the above query when it is executed on the above instance of relation R and S is ___

# Summary

| OPERATION | PURPOSE | NOTATION |
|---|---|---|
| SELECT | Selects all tuples that satisfy the selection condition from a relation R. | $\sigma_{\text{<selection condition>}}(R)$ |
| PROJECT | Produces a new relation with only some of the attributes of R, and removes duplicate tuples. | $\pi_{\text{<attribute list>}}(R)$ |
| THETA JOIN | Produces all combinations of tuples from $R_1$ and $R_2$ that satisfy the join condition. | $R_1 \bowtie_{\text{<join condition>}} R_2$ |
| EQUIJOIN | Produces all the combinations of tuples from $R_1$ and $R_2$ that satisfy a join condition with only equality comparisons. | $R_1 \bowtie_{\text{<join condition>}} R_2$, OR $R_1 \bowtie_{\text{(<join condition 1>), (<join condition 1>)}} R_2$ |
| NATURAL JOIN | Same as EQUIJOIN except that the join attributes of $R_2$ are not included in the resulting relation; if the join attributes have the same names, they do not have to be specified at all. | $R_1 *_{\text{<join condition>}} R_2$, OR $R_1 *_{\text{(<join attributes 1>), (<join attributes 2>)}} R_2$ OR $R_1 * R_2$ |

| OPERATION | PURPOSE | NOTATION |
| --- | --- | --- |
| UNION | Produces a relation that includes all the tuples in $R_1$ or $R_2$ or both $R_1$ and $R_2$; $R_1$ and $R_2$ must be union compatible. | $R_1 \cup R_2$ |
| INTERSECTION | Produces a relation that includes all the tuples in both $R_1$ and $R_2$; $R_1$ and $R_2$ must be union compatible. | $R_1 \cap R_2$ |
| DIFFERENCE | Produces a relation that includes all the tuples in $R_1$ and that are not in $R_2$; $R_1$ and $R_2$ must be union compatible. | $R_1 - R_2$ |
| CARTESIAN PRODUCT | Produces a relation that has the attributes of $R_1$ and $R_2$ and includes as tuples all possible combinations of tuples from $R_1$ and $R_2$. | $R_1 \times R_2$ |
| DIVISION | Produces a relation $R(X)$ that includes all tuples $t[X]$ in $R_1(Z)$ that appear in $R_1$ in combination with every tuple from $R_2(Y)$, where $Z = X \cup Y$ | $R_1(Z) \div R_2(Y)$ |

# NAT

Consider a database that has the relation schema CR(StudentName, CourseName). An instance of the schema CR is as given below:

The following query is made on the database.

$T1 \leftarrow \pi_{CourseName}(\sigma_{StudentName='SA'}(CR))$

$T_1 = \boxed{\begin{matrix} CA \\ CB \\ CC \end{matrix}}$

$T2 \leftarrow CR \div T1;$

The number of rows in T2 is ________.

[GATE-2017-CS: 2M]

| CR | |
|---|---|
| Student Name | Course Name |
| SA | CA |
| SA | CB |
| SA | CC |
| SB | CB |
| SB | CC |
| SC | CA |
| SC | CB |
| SC | CC |
| SD | CA |
| SD | CB |
| SD | CC |
| SD | CD |
| SE | CD |
| SE | CA |
| SE | CB |
| SF | CA |
| SF | CB |
| SF | CC |

CR ÷ $T_1$ $\boxed{\begin{matrix} CA \\ CB \\ CC \end{matrix}}$

CR ÷ CA

Step 1

| |
|---|
| SA |
| SC |
| SD |
| SE |
| SF |

CR ÷ CA
CB

Step 2

| | |
|---|---|
| SA | ✓ |
| SC | ✓ |
| SD | ✓ |
| SF | ✗ |
| SF | |

Step 3

CR ÷ CA
CB
CC

| | |
|---|---|
| SA | ✗ |
| SC | ✗ |
| SD | ✓ |
| SF | |

Ans

Divide Now Extra By CD

CR ÷ CA
CB
CC
CD

then Ans ?

$\boxed{SD}$ Ans

# MCQ

The following relation records the age of 500 employees of a company, where empNo {indicating the employee number} is the key:

empAge(<u>empNo</u>, age)

Consider the following relational algebra expression:

$\Pi_{empNo}(\text{empAge} \bowtie_{(age>age1)} \rho_{empNo1,age1}(\text{empAge}))$

What does the above expression generate? [GATE-2020-CS: 1M]

A. Employee numbers of only those employees whose age is the maximum

B. Employee numbers of only those employees whose age is more than the age of exactly one other employee

C. Employee numbers of all employees whose age is not the minimum

D. Employee numbers of all employees whose age is the minimum

# NAT

Consider the following relations P(X, Y, Z), Q(X, Y, T) and R(Y, V)

| P | | |
|---|---|---|
| X | Y | Z |
| X1 | Y1 | Z1 |
| X1 | Y1 | Z2 |
| X2 | Y2 | Z2 |
| X2 | Y4 | Z4 |

| Q | | |
|---|---|---|
| X | Y | T |
| X2 | Y1 | 2 |
| X1 | Y2 | 5 |
| X1 | Y1 | 6 |
| X3 | Y3 | 1 |

| R | |
|---|---|
| Y | V |
| Y1 | V1 |
| Y3 | V2 |
| Y2 | V3 |
| Y2 | V2 |

How many tuples will be returned by the following relational algebra query?

$[\Pi_X(\sigma_{(P.Y=R.Y \wedge R.V=V2)}(P \times R)) - \Pi_X(\sigma_{(Q.Y=R.Y \wedge Q.T>2)}(Q \times R))];$

[GATE-2019-CS: 2M]

# MCQ

Suppose $R_1(\underline{A}, B)$ and $R_2(\underline{C}, D)$ are two relation schemes. Let $r_1$ and $r_2$ be the corresponding relation instances. B is a foreign key that refers to C in $R_2$. If data in $r_1$ and $r_2$ satisfy referential integrity constraints, which of the following is ALWAYS TRUE?

[GATE-2013-CS: 2M]

A. $\Pi_B(r_1) - \Pi_C(r_2) = \phi$

B. $\Pi_C(r_2) - \Pi_B(r_1) = \phi$

C. $\Pi_B(r_1) = \Pi_C(r_2)$

D. $\Pi_B(r_1) - \Pi_C(r_2) \neq \phi$

## NAT

Consider the following table named Student in a relational database. The primary key of this table is rollNum.

Student

| Roll Num | Name | Gender | Marks |
|---|---|---|---|
| 1 | Naman | M | 62 |
| 2 | Aliya | F | 70 |
| 3 | Aliya | F | 80 |
| 4 | James | M | 82 |
| 5 | Swati | F | 65 |

The SQL query below is executed on this database.

```
SELECT *
FROM Student
WHERE gender = 'F' AND marks > 65;
```

The number of rows returned by the query is

[GATE-2023-CS: 2M]

# MCQ

Consider the following relation A, B and C:

| A | | |
|---|---|---|
| ID | Name | Age |
| 12 | Arun | 60 |
| 15 | Shreya | 24 |
| 99 | Rohit | 11 |

| B | | |
|---|---|---|
| ID | Name | Age |
| 15 | Shreya | 24 |
| 25 | Hari | 40 |
| 98 | Rohit | 20 |
| 99 | Rohit | 11 |

| C | | |
|---|---|---|
| ID | Phone | Area |
| 10 | 2200 | 02 |
| 99 | 2100 | 01 |

How many tuples does the result of the following relational algebra expression contain? Assume that the schema of $A \cup B$ is the same as that of A.

$(A \cup B) \bowtie_{A.Id > 40 \vee C.Id < 15} C$

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(A) 7

(B) 4

(C) 5

(D) 9

THANK
YOU!