

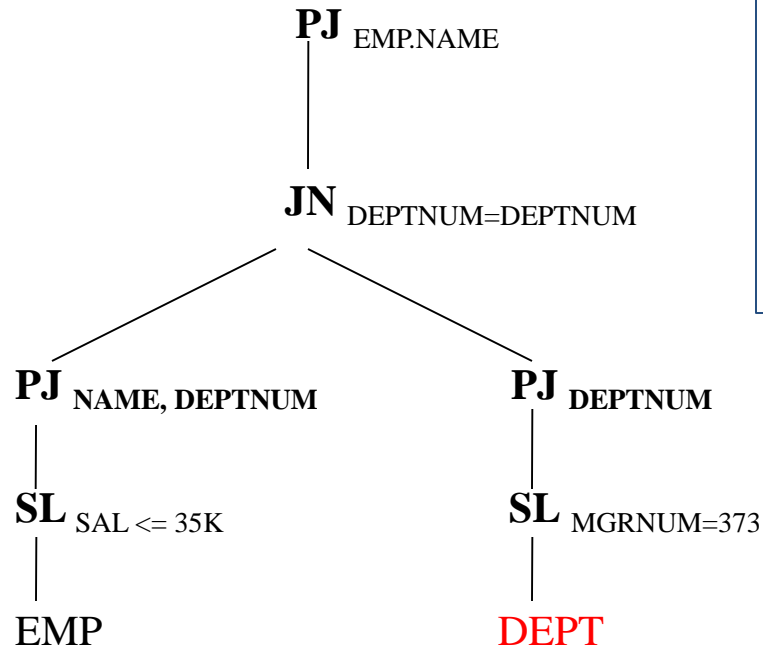
# CSE 4125: Distributed Database Systems Chapter – 5

Translation of Global Queries to  
Fragment Queries.  
(Part – G)

# Topics to be discussed –

- Qualified Relation

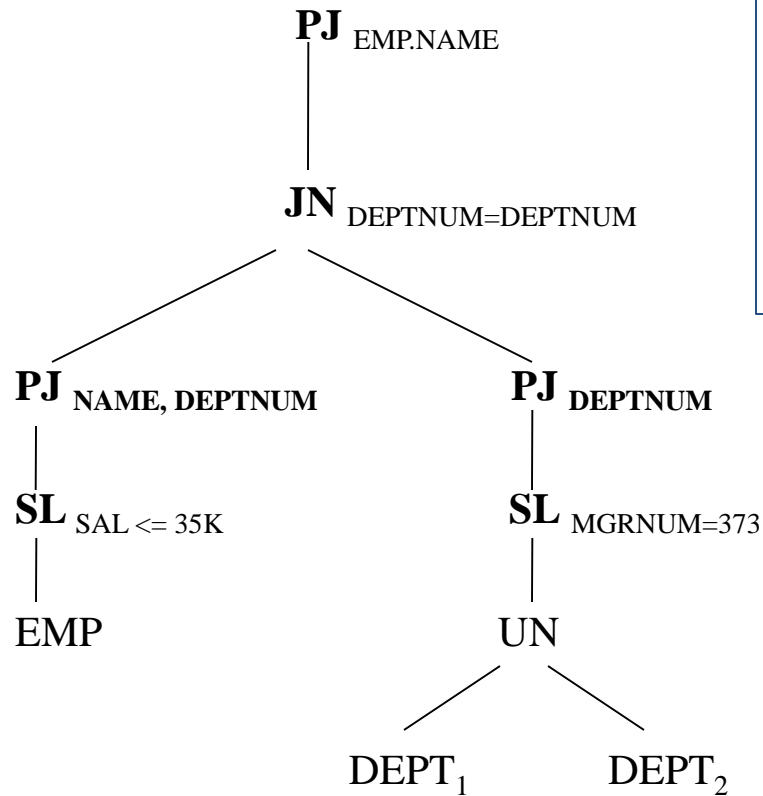
# Qualified Relation



Say, DEPT has 2 fragments:  
DEPT<sub>1</sub> and DEPT<sub>2</sub>.

**DEPT<sub>1</sub> : SL<sub>deptnum <= 10</sub> DEPT**

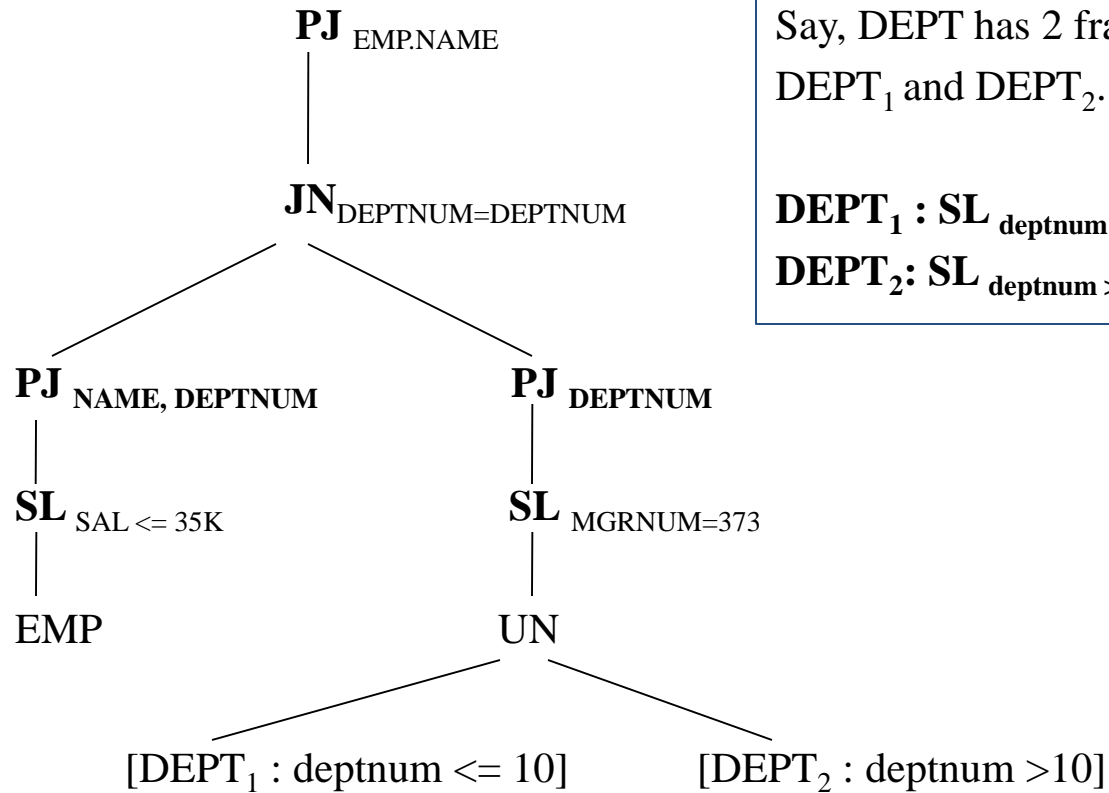
**DEPT<sub>2</sub> : SL<sub>deptnum > 10</sub> DEPT**



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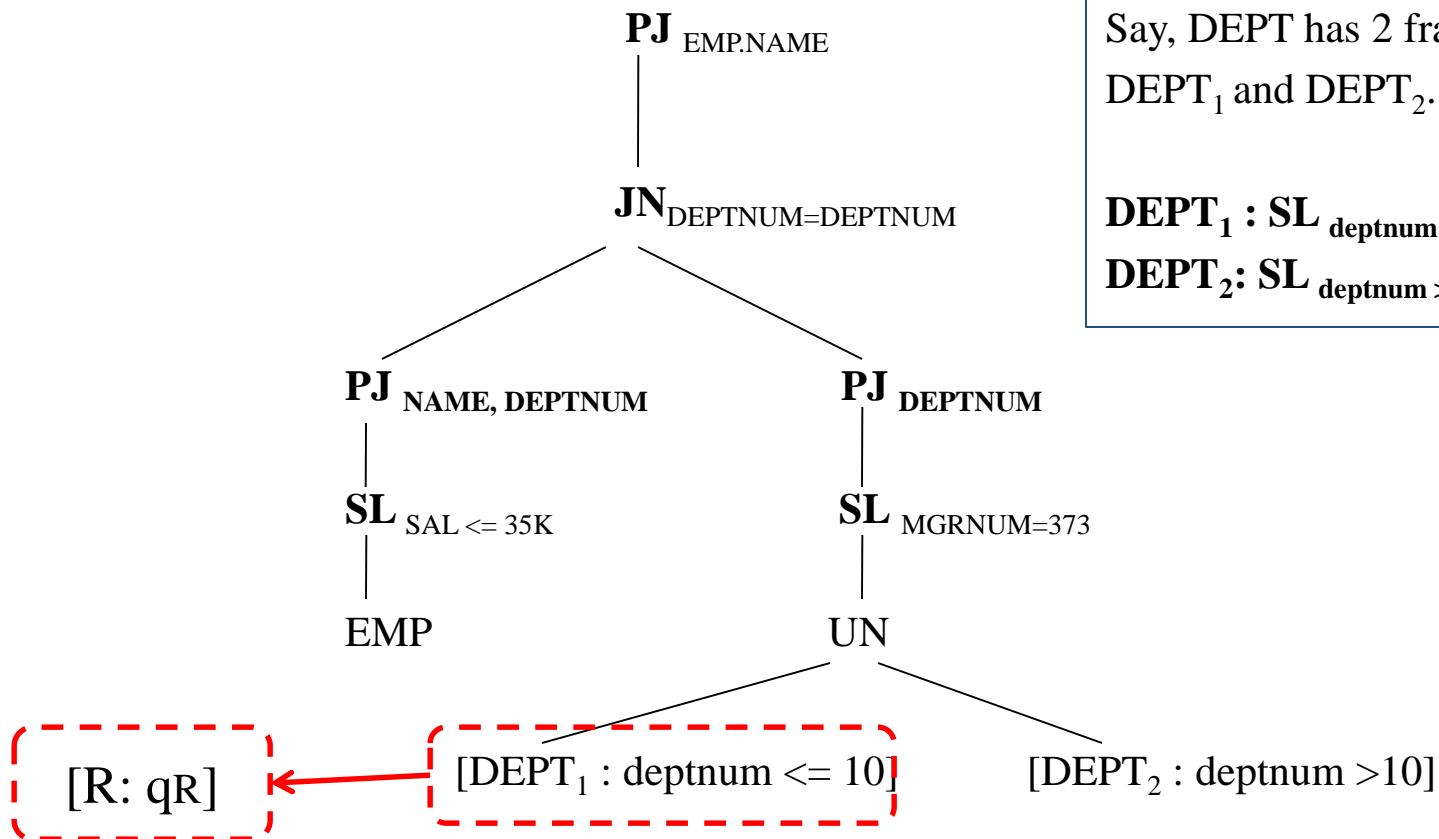
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## A Qualified relation –

- Is a relation extended by a qualification.
- Is denoted as a pair [**R : qR**], where **R** is a relation called **body** and **qR** is a predicate called **qualification**.
  - Qualifications can be seen as an intentional property possessed by all the tuples of the relation. For example all the tuples in **R** satisfies **qR**.

# Algebra of Qualified Relation

- We know **relational algebra** uses **relations** as operands.
  - For example,  $SL_F \mathbf{R}$
- **Algebra of qualified relation** uses **qualified relations** as operands.
  - For example,  $SL_F [\mathbf{R: qR}]$



# Rules of Algebra of Qualified Relation

**Rule 1:**  $\mathbf{SL}_F [R : qR] \rightarrow [\mathbf{SL}_F R : F \text{ and } qR]$

**Rule 2:**  $\mathbf{PJ}_A [R : qR] \rightarrow [\mathbf{PJ}_A R : qR]$

**Rule 3:**  $[R : qR] \mathbf{CP} [S : qS] \rightarrow [R \mathbf{CP} S : qR \text{ and } qS]$

**Rule 4:**  $[R : qR] \mathbf{DF} [S : qS] \rightarrow [R \mathbf{DF} S : qR]$

**Rule 5:**  $[R : qR] \textbf{UN} [S : qS] \rightarrow [R \textbf{UN} S : qR \textit{ or } qS]$

**Rule 6:**  $[R : qR] \textbf{JN}_F[S : qS] \rightarrow [R \textbf{JN}_F S : qR \textit{ and } qS \textit{ and } F]$

**Rule 7:**  $[R : qR] \textbf{SJ}_F[S : qS] \rightarrow [R \textbf{SJ}_F S : qR \textit{ and } qS \textit{ and } F]$

# Rules of Algebra of Qualified Relation

Rule 1:  $SL_F[R : qR] \rightarrow [SL_F R : F \text{ and } qR]$

$[ACCOUNT_1 : ID < 5]$

ID	NAME	CITY
1	a	dhk
2	b	dhk
3	c	ctg
4	d	ctg

$SL_{CITY = dhk} [ACCOUNT_1 : ID < 5]$

ID	NAME	CITY
1	a	dhk
2	b	dhk

$[SL_{CITY = dhk} ACCOUNT_1 : ID < 5 \text{ and } CITY = dhk]$

ID	NAME	CITY
1	a	dhk
2	b	dhk

# Proof of Rule 6

**Rule 6:**  $[R : qR] \mathbf{JN}_F[S : qS] \rightarrow [R \mathbf{JN}_F S : qR \text{ and } qS \text{ and } F]$

$[R : qR] \mathbf{JN}_F[S : qS]$

$\Rightarrow \mathbf{SL}_F ([R : qR] \mathbf{CP} [S : qS]) \rightarrow \text{Rule 3}$

$\Rightarrow \mathbf{SL}_F [R \mathbf{CP} S : qR \text{ and } qS] \rightarrow \text{Rule 1}$

$\Rightarrow [\mathbf{SL}_F (R \mathbf{CP} S) : qR \text{ and } qS \text{ and } F]$

$\Rightarrow [R \mathbf{JN}_F S : qR \text{ and } qS \text{ and } F]$

# Proof of Rule 7

**Rule 7:**  $[R : qR] \text{ SJ}_F[S : qS] \rightarrow [R \text{ SJ}_F S: qR \text{ and } qS \text{ and } F]$

$[R : qR] \text{ SJ}_F[S : qS]$

$\Rightarrow \text{PJ}_{\text{Attr}(\mathbf{R})} ([R : qR] \text{ JN}_F [S : qS]) \rightarrow \text{Rule 6}$

$\Rightarrow \text{PJ}_{\text{Attr}(\mathbf{R})} [R \text{ JN}_F S: qR \text{ and } qS \text{ and } F ] \rightarrow \text{Rule 2}$

$\Rightarrow [\text{PJ}_{\text{Attr}(\mathbf{R})} (R \text{ JN}_F S): qR \text{ and } qS \text{ and } F ]$

$\Rightarrow [R \text{ SJ}_F S: qR \text{ and } qS \text{ and } F ]$

# Example 1

\* Compute the following expression using algebra of qualified relation:

$$SL_{qs}((\underbrace{[R : q_r] \text{ CP } [S : q_s]}_{\text{CP}}) \text{ JN}_F(\underbrace{[M : q_m] \text{ DF } [S : q_s]}_{\text{DF}}))$$

$$\Rightarrow SL_{qs}(\underbrace{[R \text{ CP } S : q_r \text{ AND } q_s] \text{ JN}_F[M \text{ DF } S : q_m]}_{\text{JN}_F})$$

$$\Rightarrow SL_{qs} \left[ \underbrace{(R \text{ CP } S) \text{ JN}_F (M \text{ DF } S) : (q_r \text{ AND } q_s) \text{ AND } q_m \text{ AND } F}_{\text{AND } F} \right]$$

$$\Rightarrow [SL_{qs}((R \text{ CP } S) \text{ JN}_F (M \text{ DF } S)) : ((q_r \text{ AND } q_s) \text{ AND } q_m \text{ AND } F) \text{ AND } q_s]$$

\* Note: You will stop when you reach all the expressions as a form of qualified relation (inside the  $[ ]$ )

# Example 2



\* Compute the following expression using algebra of qualified relation:

$$SL_{q_r} (([R : q_r] \cup [S : q_s]) \Join_F ([M : q_m] \text{ CP } [S : q_s]))$$

$$\Rightarrow SL_{q_r} (([R : q_r] \cup [S : q_s]) \Join_F [M \text{ CP } S : q_m \text{ AND } q_s])$$

$$\Rightarrow SL_{q_r} ([R \cup S : q_r \text{ OR } q_s] \Join_F [M \text{ CP } S : q_m \text{ AND } q_s])$$

$$\Rightarrow SL_{q_r} [(R \cup S) \Join_F (M \text{ CP } S) : (q_r \text{ OR } q_s) \text{ AND } (q_m \text{ AND } q_s) \text{ AND } F]$$

$$\Rightarrow [SL_{q_r} ((R \cup S) \Join_F (M \text{ CP } S)) : ((q_r \text{ OR } q_s) \text{ AND } (q_m \text{ AND } q_s) \text{ AND } F) \text{ AND } q_r]$$

# Example 3

\* Evaluate the following expression using the rules of algebra of qualified relations.

$$[M : q_m] \text{ DF } (([R : q_R] \text{ UN } [S : q_S]) \text{ SJ}_F ([M : q_m] \text{ CP } [S : q_S]))$$

$$\Rightarrow [M : q_m] \text{ DF } ([R \text{ UN } S : q_R \text{ OR } q_S] \text{ SJ}_F ([M : q_m] \text{ CP } [S : q_S]))$$

$$\Rightarrow [M : q_m] \text{ DF } ([R \text{ UN } S : q_R \text{ OR } q_S] \text{ SJ}_F [M \text{ CP } S : q_m \text{ AND } q_S])$$

$$\Rightarrow [M : q_m] \text{ DF } [(R \text{ UN } S) \text{ SJ}_F (M \text{ CP } S) : (q_R \text{ OR } q_S) \text{ AND } (q_m \text{ AND } q_S) \text{ AND F}]$$

$$\Rightarrow [M \text{ DF } ((R \text{ UN } S) \text{ SJ}_F (M \text{ CP } S)) : q_m]$$



## Exercise :

Evaluate the following expression using the rules of algebra of qualified relations. Show the steps and indicate the rules applied.

$$\textcircled{1} (([R : q_r] \cup [S : q_s]) \bowtie_F ([P : q_p] \bowtie_H [T : q_t])) \\ \text{DF } [M : q_m]$$

$$\textcircled{2} SL_{\text{NOT } b} ((([R_1 : a] \bowtie_F [S_1 : b]) \cup ([R_2 : \text{NOT } a] \bowtie_F [S_1 : b])) \text{DF } ([T_1 : c] \bowtie_F [S_2 : \text{NOT } b]))$$

# Some More Rules

$$\mathbf{SL}_F(\emptyset) \leftrightarrow \emptyset$$

$$\mathbf{PJ}_A(\emptyset) \leftrightarrow \emptyset$$

$$R \mathbf{CP} \emptyset \leftrightarrow \emptyset$$

$$R \mathbf{UN} \emptyset \leftrightarrow R$$

$$R \mathbf{DF} \emptyset \leftrightarrow R$$

$$\emptyset \mathbf{DF} R \leftrightarrow \emptyset$$

$$R \mathbf{JN}_F \emptyset \leftrightarrow \emptyset$$

$$R \mathbf{SJ}_F \emptyset \leftrightarrow \emptyset$$

$$\emptyset \mathbf{SJ}_F R \leftrightarrow \emptyset$$

THANK YOU  
FROM  
CHAPTER 5