

CSE 4125: Distributed Database Systems Chapter – 5

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

Global Query: Query over a Global Relation.

Fragment Query: Query over Fragments.

Example: Say, $R(A, B, C)$ is a Global Relation. It has two horizontal fragments: R_1, R_2

Then,

$SL_F R$ is an example of Global Query.

$SL_F R_1$ or $PJ_{A, B} R_2$ are the examples of Fragment Query.

Query Transform

From Chapter 3:

Level – 1 Transparency

Level – 2 Transparency

Level – 3 Transparency

Global Query \rightarrow Fragment Query

Some Things to Learn

- Operator Tree
- Simplification of Operator Tree
- Equivalent Expressions of Global Queries
- Translation of Global Query to Fragment Query
- Canonical Expression

Some more topics to be mentioned..

Operator Tree

- More practical representation for queries.

Leaves – Global Relation

Nodes – Operators (Unary/Binary)

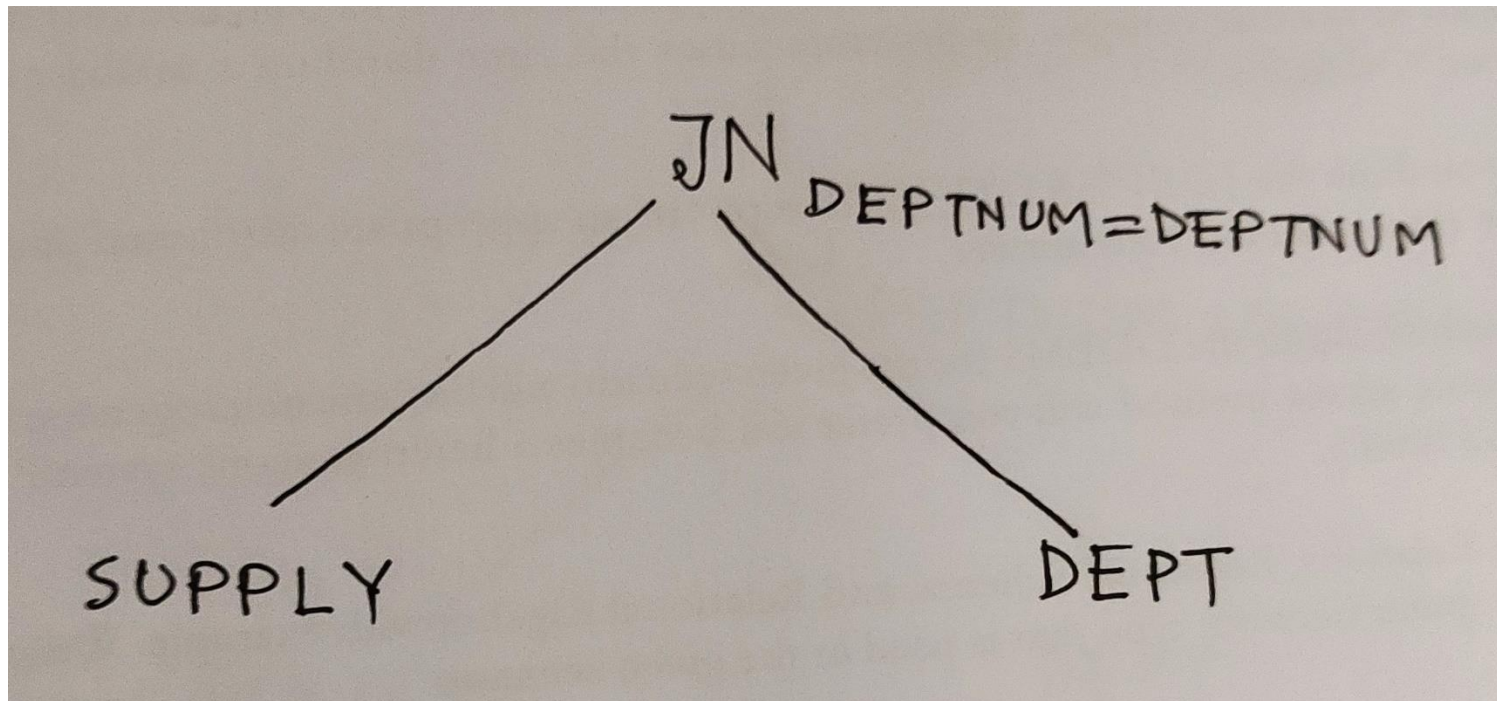
- Gives us the order of applying queries.
- Unary operator – Selection, Projection
- Binary operator – Union, Join, NJN, CP etc..

Operator Tree

SUPPLY (SNUM, PNUM, DEPTNUM, QUAN)

DEPT (DEPTNUM, NAME, AREA, MGRNUM)

Q1: *SUPPLY* **JN** _{DEPTNUM=DEPTNUM} *DEPT*

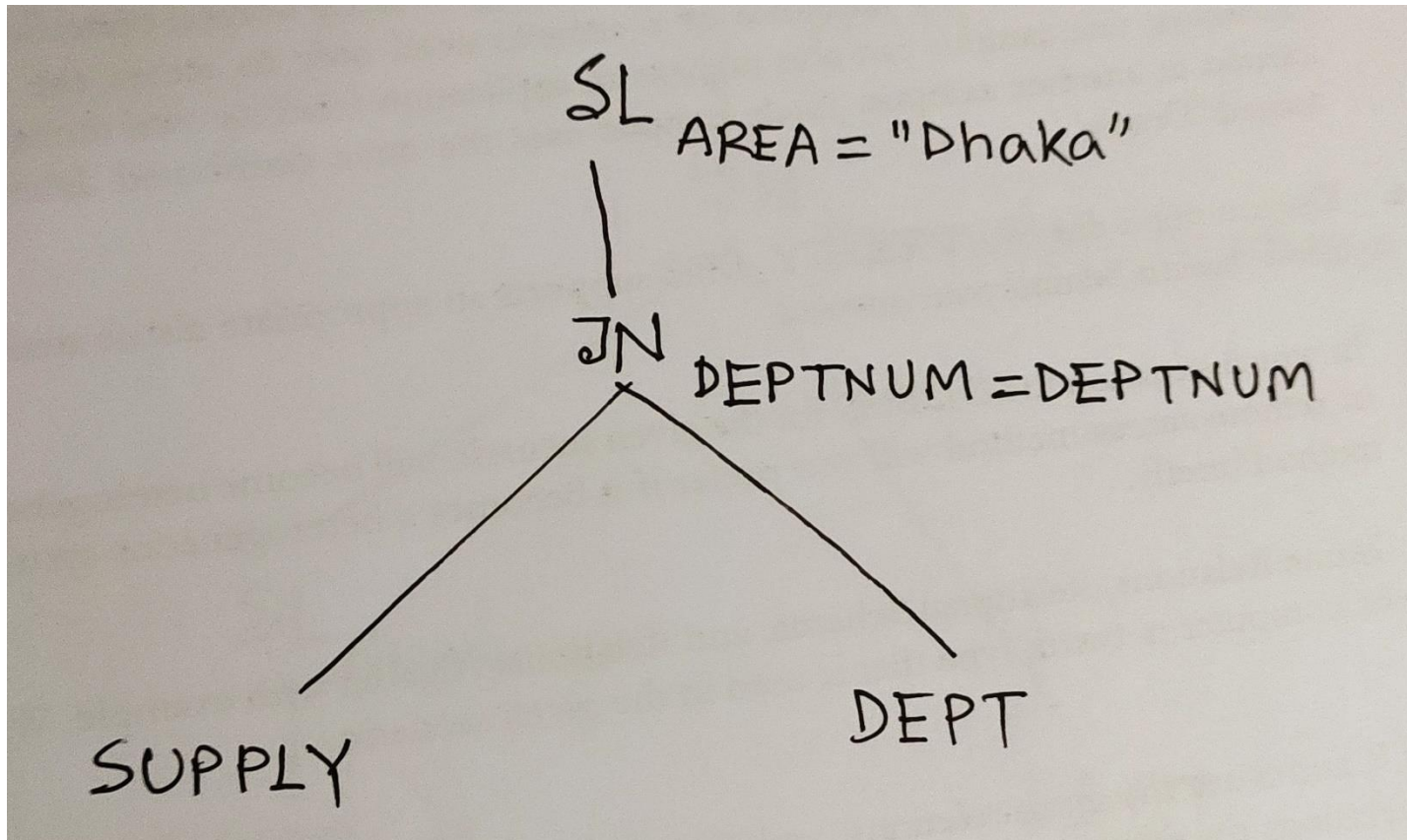


Operator Tree

SUPPLY (SNUM, PNUM, DEPTNUM, QUAN)

DEPT (DEPTNUM, NAME, AREA, MGRNUM)

Q2: $SL_{AREA="Dhaka"} (SUPPLY \Join_{DEPTNUM=DEPTNUM} DEPT)$

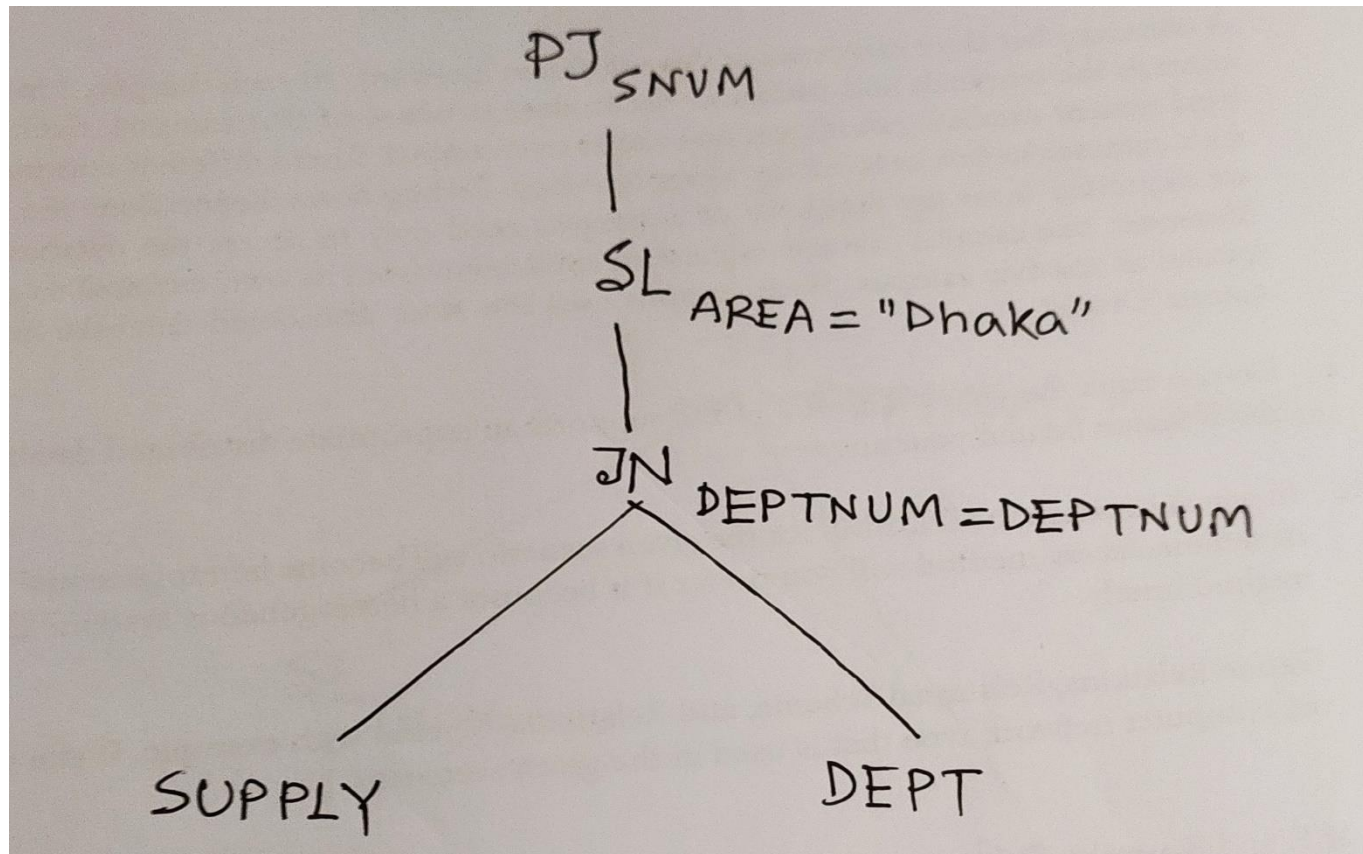


Operator Tree

SUPPLY (*SNUM*, *PNUM*, *DEPTNUM*, *QUAN*)

DEPT (*DEPTNUM*, *NAME*, *AREA*, *MGRNUM*)

Q3: PJ _{SNUM} **SL** _{AREA="Dhaka"} (**SUPPLY JN** _{DEPTNUM=DEPTNUM} **DEPT**)

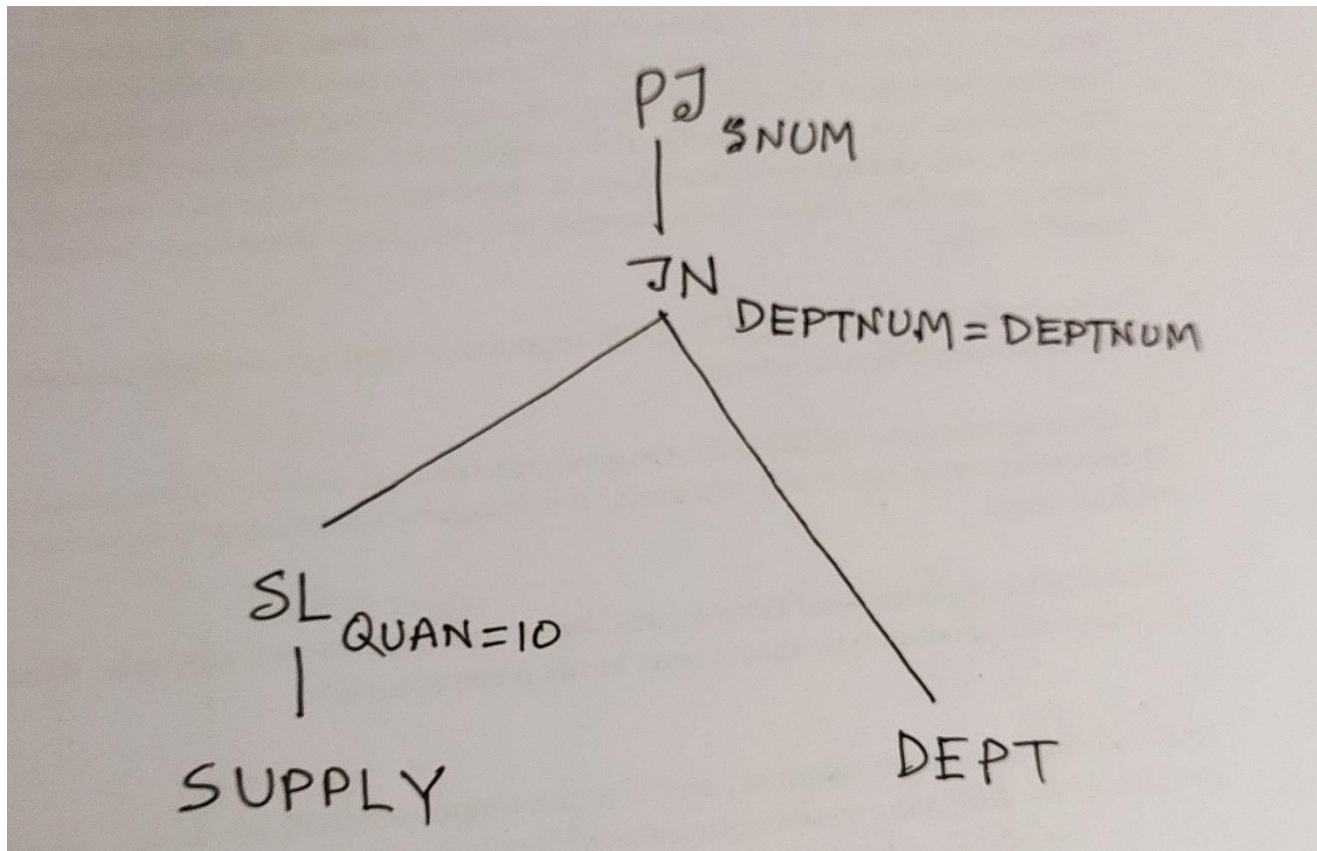


Operator Tree

SUPPLY (*SNUM*, *PNUM*, *DEPTNUM*, *QUAN*)

DEPT (*DEPTNUM*, *NAME*, *AREA*, *MGRNUM*)

Q4: $PJ_{SNUM} (SL_{QUAN=10} SUPPLY JN_{DEPTNUM=DEPTNUM} DEPT)$

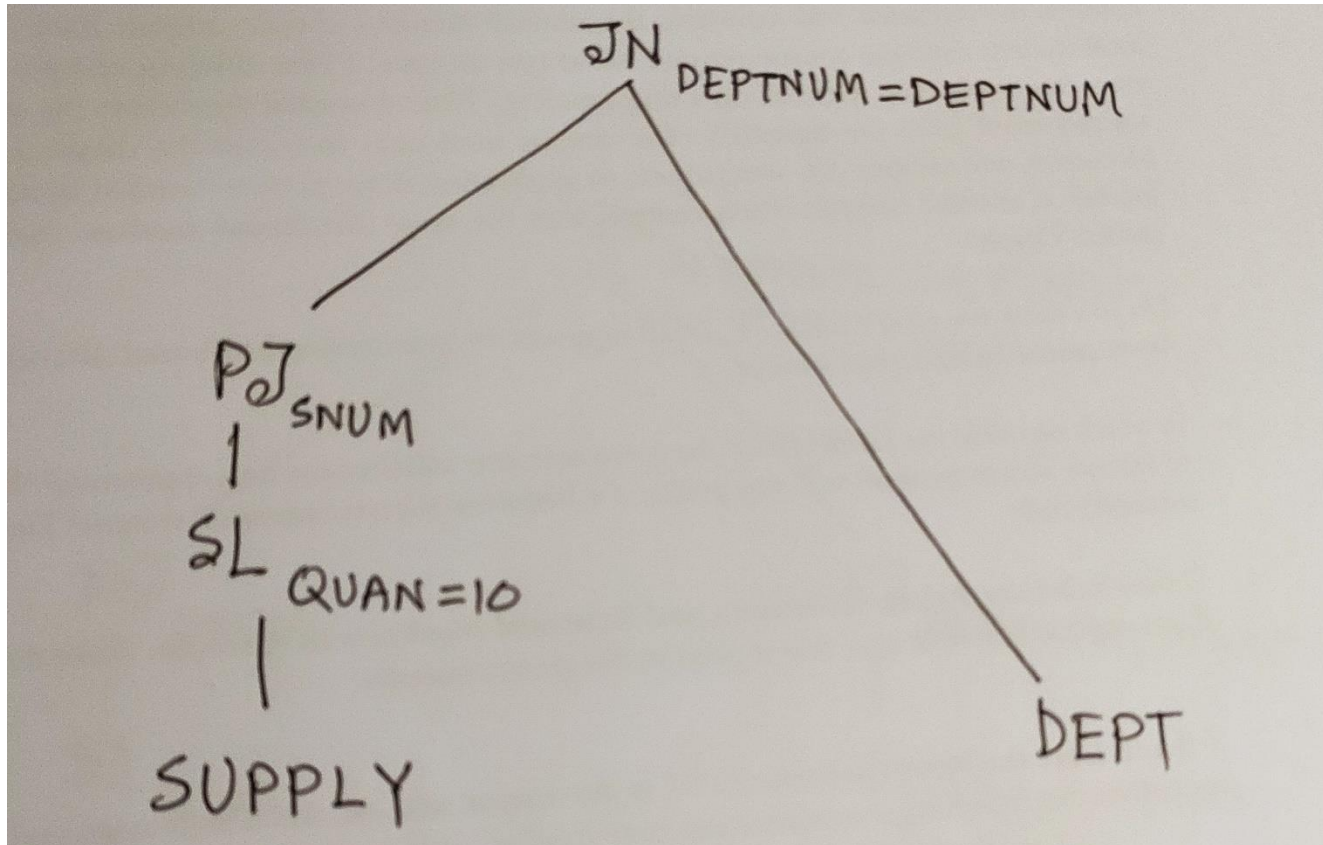


Operator Tree

SUPPLY (*SNUM*, *PNUM*, *DEPTNUM*, *QUAN*)

DEPT (*DEPTNUM*, *NAME*, *AREA*, *MGRNUM*)

Q5: (**PJ**_{SNUM} **SL**_{QUAN=10} *SUPPLY* **JN**_{DEPTNUM=DEPTNUM} *DEPT*)

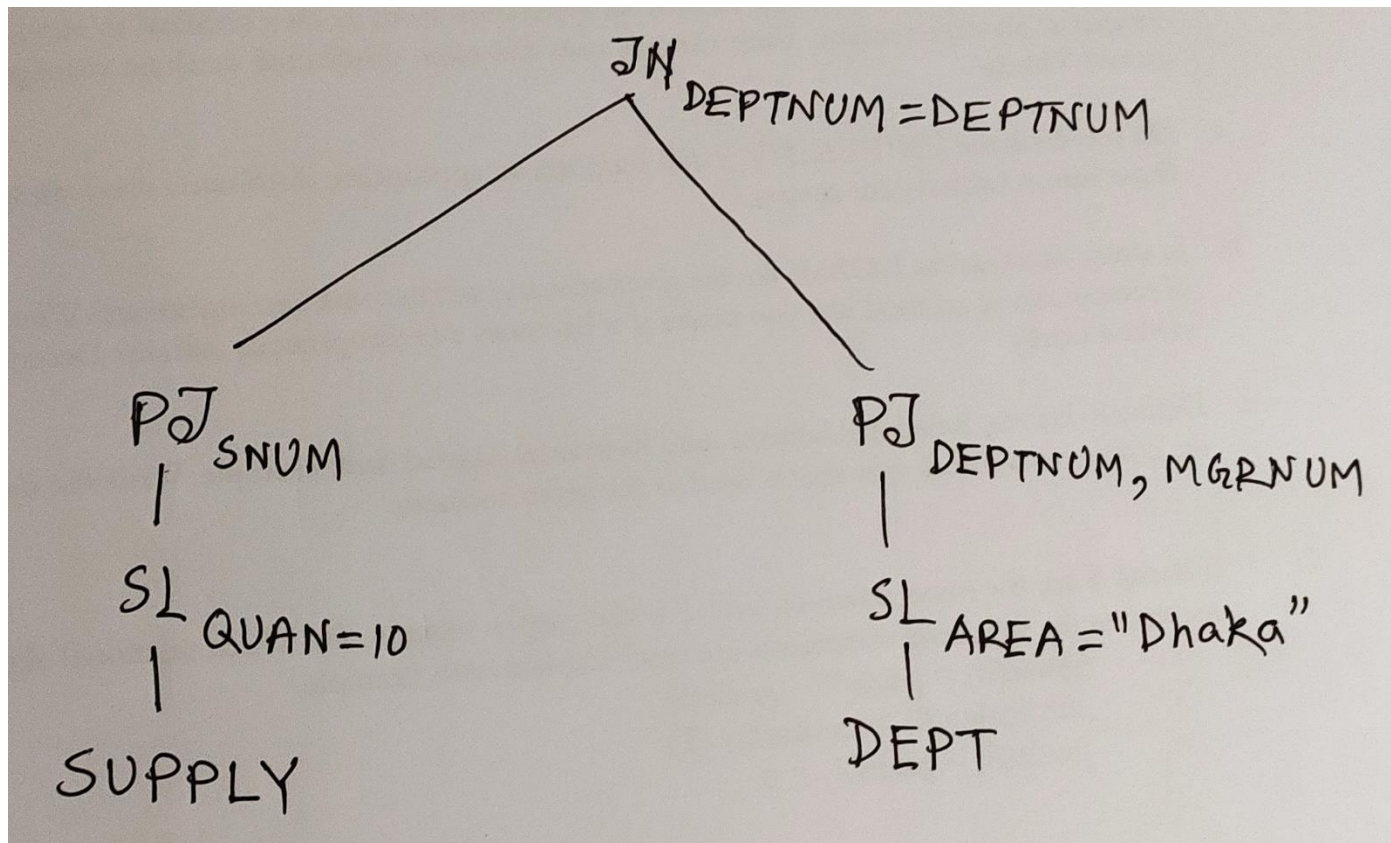


Operator Tree

SUPPLY (*SNUM*, *PNUM*, *DEPTNUM*, *QUAN*)

DEPT (*DEPTNUM*, *NAME*, *AREA*, *MGRNUM*)

Q6: (**PJ** _{*SNUM*} **SL** _{*QUAN=10*} *SUPPLY* **JN** _{*DEPTNUM=DEPTNUM*} **PJ**
_{*DEPTNUM, MGRNUM*} **SL** _{*AREA="Dhaka"*} *DEPT*)



Practice Session

EMP (EMPNUM, DEPTNUM, NAME, SAL, AGE)

DEPT (DEPTNUM, NAME, AREA, MGRNUM)

Q7: PJ _{EMP.NAME} ((*EMP JN* _{DEPTNUM=DEPTNUM} **SL** _{MGRNUM=373} *DEPT*)
CP (**SL** _{SAL > 35K} *EMP JN* _{DEPTNUM=DEPTNUM} **SL** _{MGRNUM=373} *DEPT*))

Operator Tree for Q7?

Practice Session (answer)

Q7: PJ EMP.NAME ((EMP JN DEPTNUM=DEPTNUM **SL** MGRNUM=373 DEPT)
CP (**SL** SAL > 35K EMP JN DEPTNUM=DEPTNUM **SL** MGRNUM=373 DEPT))

EMP

DEPT

EMP

DEPT

Practice Session (answer)

Q7: PJ EMP.NAME ((*EMP* JN DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*)
CP (*SL* SAL > 35K *EMP* JN DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*))

EMP

SL MGRNUM=373



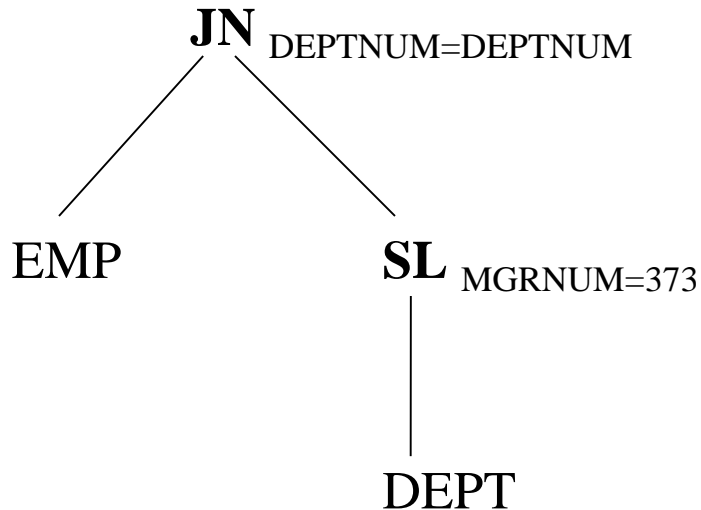
DEPT

EMP

DEPT

Practice Session (answer)

Q7: PJ EMP.NAME ((*EMP JN* DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*)
CP (*SL* SAL > 35K *EMP JN* DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*))

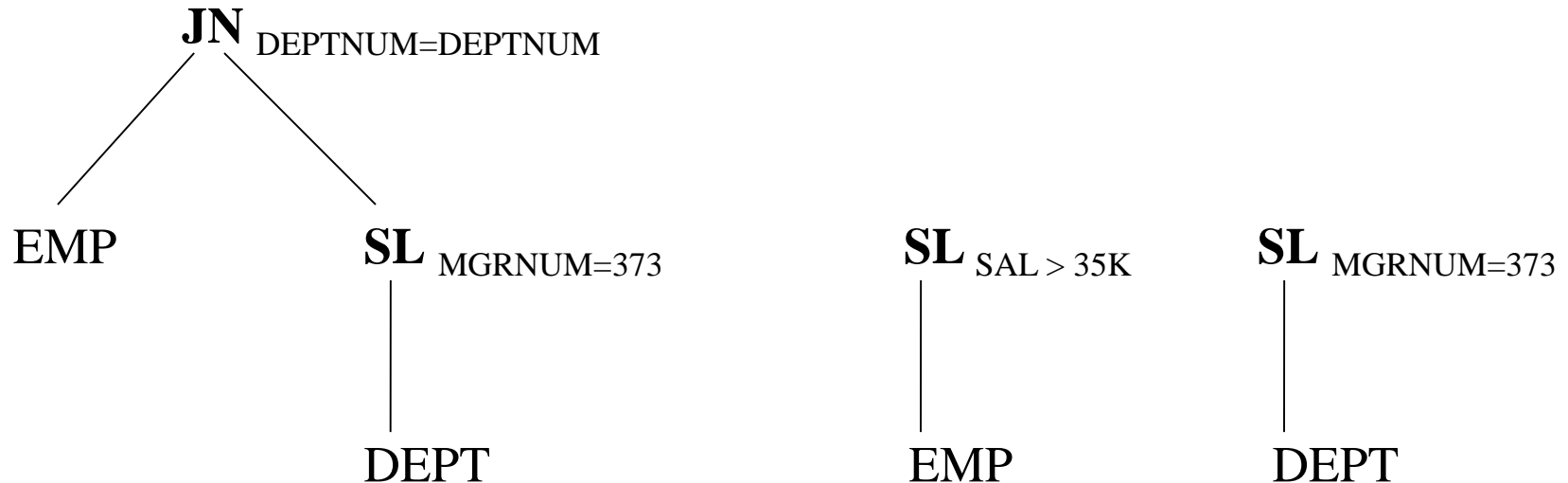


EMP

DEPT

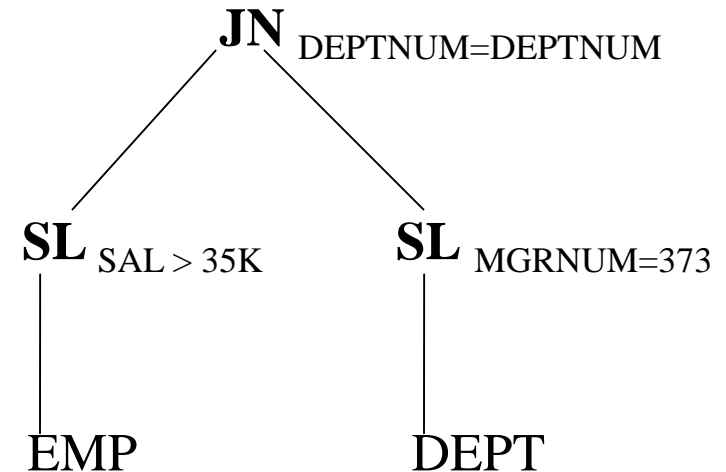
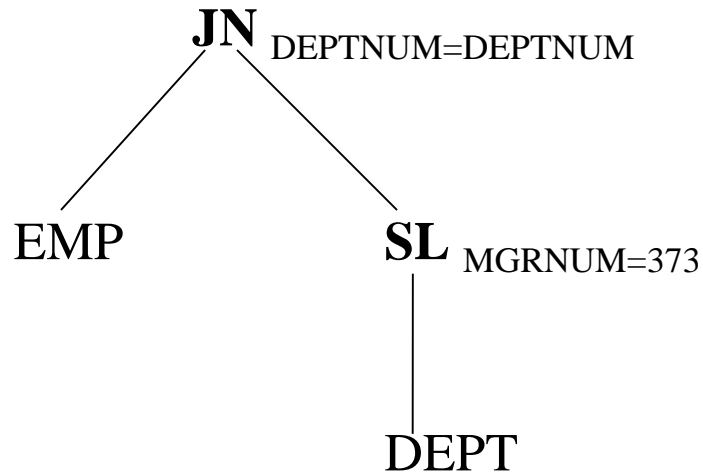
Practice Session (answer)

Q7: PJ EMP.NAME ((*EMP JN* DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*)
CP (*SL* SAL > 35K *EMP JN* DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*))



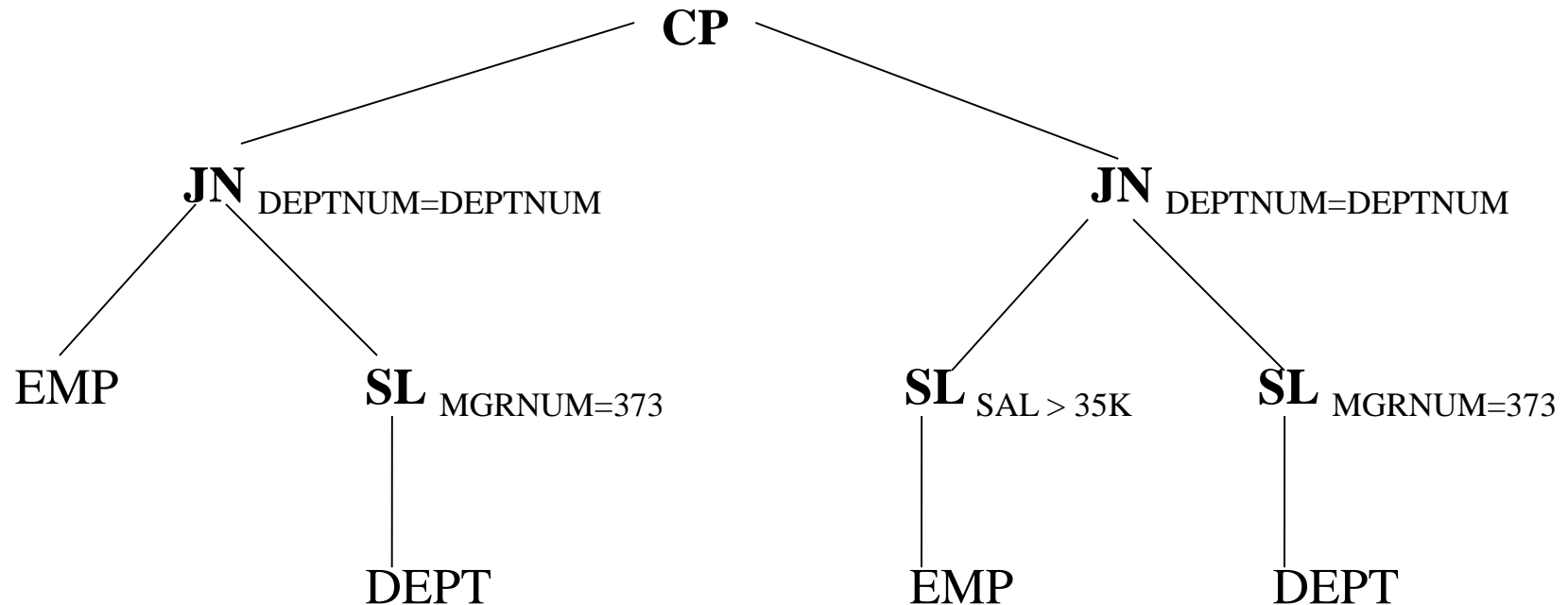
Practice Session (answer)

Q7: PJ EMP.NAME ((*EMP JN* DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*)
CP (*SL* SAL > 35K *EMP JN* DEPTNUM=DEPTNUM *SL* MGRNUM=373 *DEPT*))



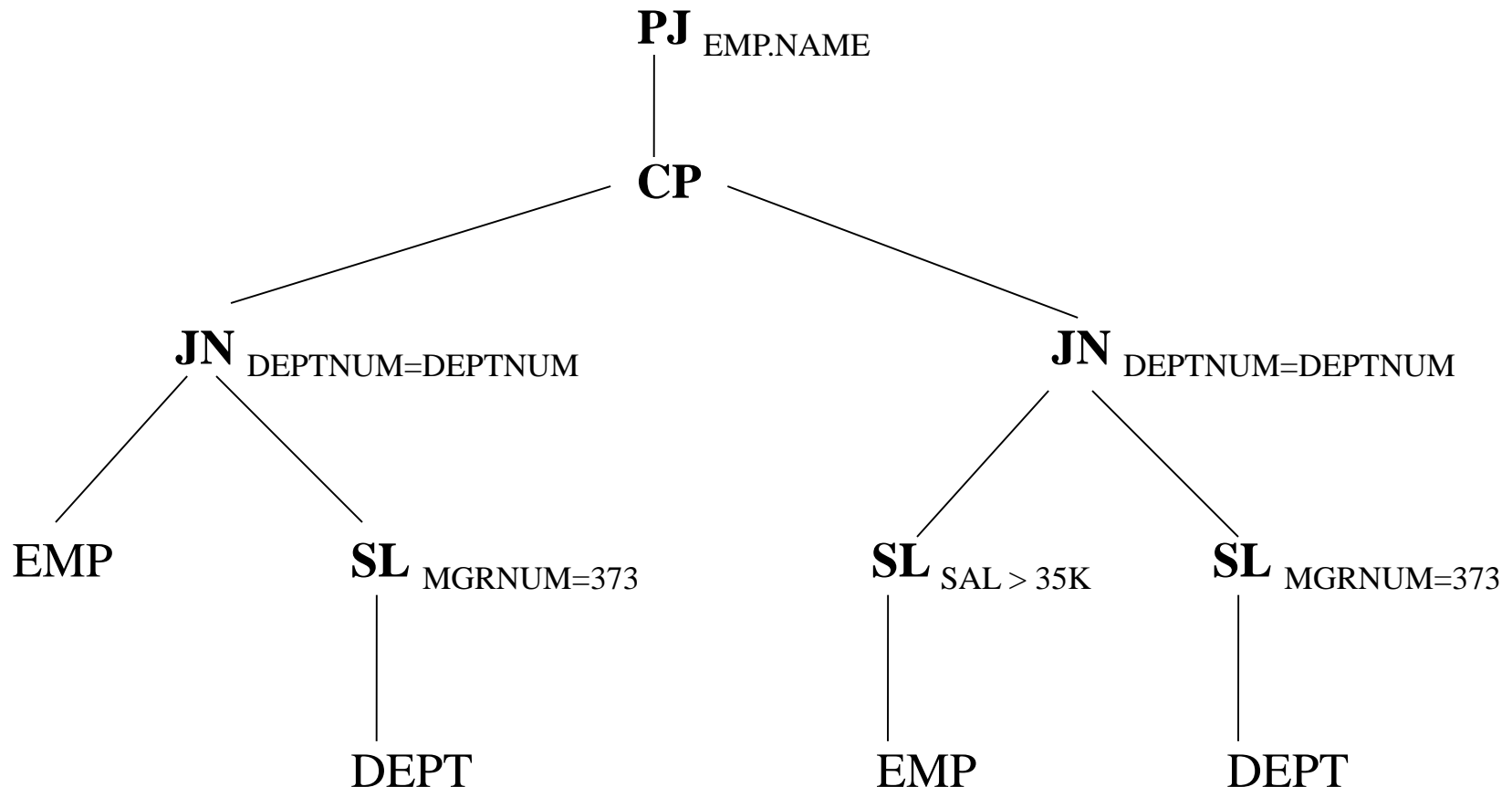
Practice Session (answer)

Q7: PJ EMP.NAME ((**EMP JN** DEPTNUM=DEPTNUM **SL** MGRNUM=373 **DEPT**)
CP (**SL** SAL > 35K **EMP JN** DEPTNUM=DEPTNUM **SL** MGRNUM=373 **DEPT**))



Practice Session (answer)

Q7: **PJ**_{EMP.NAME} ((**EMP JN**_{DEPTNUM=DEPTNUM} **SL**_{MGRNUM=373} **DEPT**)
CP (**SL**_{SAL > 35K} **EMP JN**_{DEPTNUM=DEPTNUM} **SL**_{MGRNUM=373} **DEPT**))



Exercise

Practice

* Draw Operator Tree for the following queries:

①
SUPPLY (SNUM, PNUM, DEPTNUM, QUAN)
DEPT (DEPTNUM, NAME, AREA, MGRNUM)

Query:

$(\sigma_{DEPTNUM=10} DEPT \bowtie (\sigma_{PNUM="P_1"} SUPPLY$
 $\cap \sigma_{PNUM="P_2"} SUPPLY)) \cup (\sigma_{DEPTNUM=10} DEPT$
 $\bowtie \sigma_{PNUM="P_1"} SUPPLY)$

② EMP (EMPNUM, DEPTNUM, NAME, SAL, AGE)
DEPT (DEPTNUM, NAME, AREA, MGRNUM)

Query: PJ_{NAME, TAX} ((EMP JN_{DEPTNUM=DEPTNUM} SL_{AREA="North"}
DEPT) DF (EMP JN_{DEPTNUM=DEPTNUM} SL_{DEPTNUM < 10} DEPT))

3. Consider the following global and fragmentation schemata, and a global query.

Global schema: **STUDENT** (*SNUM, SNAME, DNAME, SEM*)
DEPT (*DNAME, HEAD, PROGRAM*)

Fragmentation schema: **STUDENT**₁ = $\sigma_{SEM \geq 4 \text{ and } DNAME = \text{"EEE"}}$ **STUDENT**
STUDENT₂ = $\sigma_{SEM \geq 4 \text{ and } DNAME = \text{"CSE"}}$ **STUDENT**

DEPT₁ = $\sigma_{DNAME = \text{"EEE"}}$ **PJ**_{DNAME, PROGRAM} **DEPT**

DEPT₂ = $\sigma_{DNAME = \text{"CSE"}}$ **PJ**_{DNAME, PROGRAM} **DEPT**

DEPT₃ = **PJ**_{DNAME, HEAD} **DEPT**

(Assume that "CSE" and "EEE" are the only possible values for *DNAME*)

Global query: $(\sigma_{SEM < 4} \text{ **STUDENT**}) \cup (\sigma_{DNAME = \text{"CSE"}} \text{ **DEPT** } \bowtie \sigma_{PROGRAM = \text{"MSc"}} \text{ **DEPT**}) \cup (\sigma_{DNAME = \text{"CSE"}} \text{ **STUDENT** } \bowtie \sigma_{DNAME \neq \text{"EEE"}} \text{ **STUDENT**})$

4. Consider the following global relational schemata.

EMP (ID, NAME, SAL, AGE, MGRNUM, DEPTNUM)

DEPT (ID, AREA, DEPTNUM, MGRNUM)

Corresponding fragmentation schemata:

$EMP_1 = SL_{SAL \leq 25K} EMP$

$EMP_2 = SL_{SAL > 25K} EMP$

$DEPT_1 = SL_{AREA = "North"} DEPT$

$DEPT_2 = SL_{AREA = "South"} DEPT$

Also consider the following global query.

$PJ_{NAME, AREA}(((SL_{SAL > 25K} EMP \Join_{ID=ID} SL_{AREA = "North"} DEPT) \Join_{ID=ID} SL_{SAL \leq 25K} EMP \Join_{ID=ID} SL_{AREA = "North"} DEPT)) \Join_{ID=ID} SL_{AREA = "North"} (EMP \Join_{ID=ID} DEPT)))$

5. What will happen if we use UN instead of CP to previous query 7?

EMP (EMPNUM, DEPTNUM, NAME, SAL, AGE)

DEPT (DEPTNUM, NAME, AREA, MGRNUM)

Q7: PJ _{EMP.NAME} ((*EMP JN* _{DEPTNUM=DEPTNUM} **SL** _{MGRNUM=373} *DEPT*)
UN (**SL** _{SAL > 35K} *EMP JN* _{DEPTNUM=DEPTNUM} **SL** _{MGRNUM=373} *DEPT*))

Operator Tree for Q7?