# CSE 4125: Distributed Database Systems
# Chapter – 3 : Part E

Levels of Distributed Transparency

# Distribution transparency for update application

# Update Sub-tree

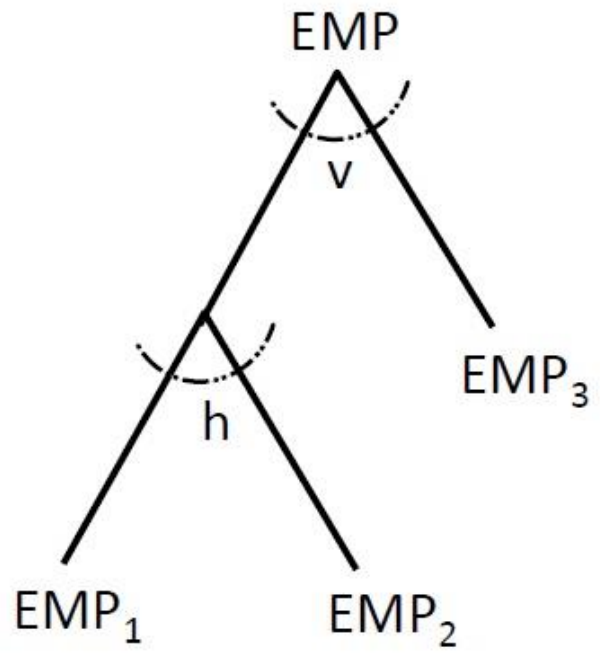
**Example:**

$EMP_1 = \boldsymbol{SL}_{\text{DEPTNUM} \leq 10} \boldsymbol{PJ}_{\text{EMPNUM, NAME, MGRNUM, DEPTNUM}} (EMP)$

$EMP_2 = \boldsymbol{SL}_{\text{DEPTNUM} > 10} \boldsymbol{PJ}_{\text{EMPNUM, NAME, MGRNUM, DEPTNUM}} (EMP)$

$EMP_3 = \boldsymbol{PJ}_{\text{EMPNUM, NAME, SAL, TAX}} (EMP)$

Which part of the tree will be effected if **DEPTNUM** is updated?



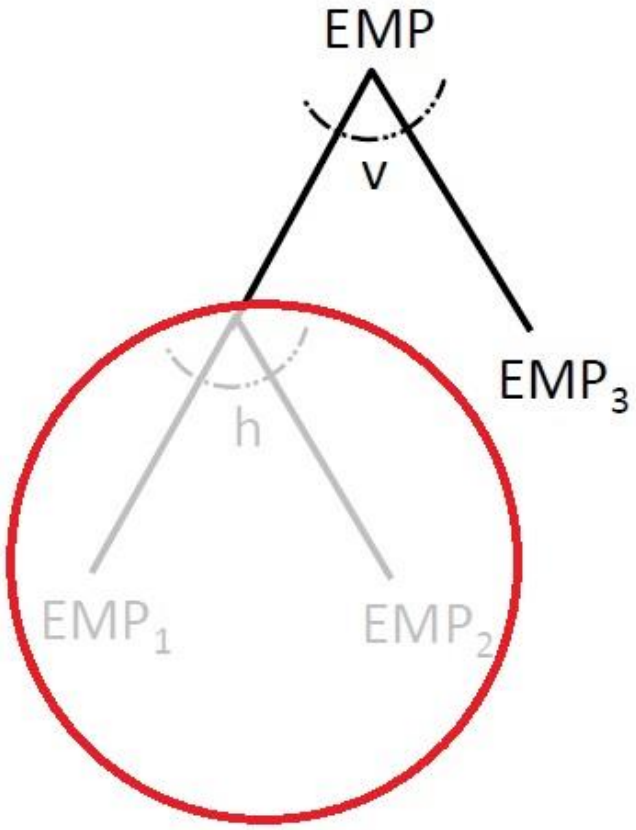
# Example:

EMP1 = $\boldsymbol{SL}_{\text{DEPTNUM} \leq 10}$ $\boldsymbol{PJ}_{\text{EMPNUM, NAME, MGRNUM, DEPTNUM}}$ (EMP)

EMP2 = $\boldsymbol{SL}_{\text{DEPTNUM} > 10}$ $\boldsymbol{PJ}_{\text{EMPNUM, NAME, MGRNUM, DEPTNUM}}$ (EMP)

EMP3 = $\boldsymbol{PJ}_{\text{EMPNUM, NAME, SAL, TAX}}$ (EMP)

Which part of the tree will be effected if **DEPTNUM** is updated?



# Objective

We analyze with an example the different levels of distribution transparency:

- Level 1: Fragmentation transparency.
- Level 2: Location transparency.
- Level 3: Local mapping transparency.

For an ***update*** application.

# Scenario

## Global schema:

*EMP (EMPNUM, NAME, SAL, TAX, MGRNUM, DEPTNUM)*

## Fragmentation schema:

$EMP_1 = \mathbf{PJ}_{EMPNUM,\ NAME,\ SAL,\ TAX}\ \mathbf{SL}_{DEPTNUM \leq 10}\ (EMP)$

$EMP_2 = \mathbf{PJ}_{EMPNUM,\ MGRNUM,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM \leq 10}\ (EMP)$

$EMP_3 = \mathbf{PJ}_{EMPNUM,\ NAME,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$

$EMP_4 = \mathbf{PJ}_{EMPNUM,\ SAL,\ TAX,\ MGRNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$

## Allocation schema:

$EMP_1$ *@ site 1, 5;* $EMP_2$ *@ site 2, 6*

$EMP_3$ *@ site 3, 7;* $EMP_4$ *@ site 4, 8*

Assume, a **UPDTEMP** application:

Updating DEPTNUM from 3 to 15 where EMPNUM is 100.

# Analyzing Level – 1 transparency

**Hint:**

Use global relation. No concept of fragments.

update *EMP*
set *DEPTNUM = 15*
where *EMPNUM = 100*.

# Analyzing Level – 2 transparency

**Hints:**

Use fragments.

- –Use the concept of *update sub-tree*.
- –Follow the *effect of update*.

**Hints:** Use fragments. Use the *update sub-tree*. Follow the *effect of update*.

- ***Store*** the necessary record from *fragments* to temporary variables.
- ***Insert*** the records into *the affected fragments* from the temporary variables.
- ***Delete*** the records from *the previous fragments*.

# Effect of Update

$$EMP_1 = \mathbf{PJ}_{\underline{EMPNUM,}\ NAME, SAL, TAX}\ \mathbf{SL}_{DEPTNUM \leq 10}\ (EMP)$$

$$EMP_2 = \mathbf{PJ}_{\underline{EMPNUM,}\ MGRNUM, DEPTNUM}\ \mathbf{SL}_{DEPTNUM \leq 10}\ (EMP)$$

$$EMP_3 = \mathbf{PJ}_{EMPNUM, NAME, DEPTNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

$$EMP_4 = \mathbf{PJ}_{EMPNUM, SAL, TAX, MGRNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

**$EMP_1$**

| EMPNUM | NAME | SAL | TAX |
|---|---|---|---|
| **100** | Smith | 10000 | 1000 |

**$EMP_2$**

| EMPNUM | MGRNUM | DEPTNUM |
|---|---|---|
| **100** | 20 | 3 |

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Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

# Effect of Update

$$EMP_1 = \mathbf{PJ}_{EMPNUM,\ NAME,\ SAL,\ TAX}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

$$EMP_2 = \mathbf{PJ}_{EMPNUM,\ MGRNUM,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

$$EMP_3 = \mathbf{PJ}_{EMPNUM,\ NAME,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

$$EMP_4 = \mathbf{PJ}_{EMPNUM,\ SAL,\ TAX,\ MGRNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

$EMP_1$

| EMPNUM | NAME | SAL | TAX |
|---|---|---|---|
| 100 | Smith | 10000 | 1000 |

$EMP_2$

| EMPNUM | MGRNUM | DEPTNUM |
|---|---|---|
| 100 | 20 | 3 |

15 ?

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

# Effect of Update

$$EMP_1 = \mathbf{PJ}_{EMPNUM,\ NAME,\ SAL,\ TAX}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

$$EMP_2 = \mathbf{PJ}_{EMPNUM,\ MGRNUM,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

$$EMP_3 = \mathbf{PJ}_{EMPNUM,\ NAME,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

$$EMP_4 = \mathbf{PJ}_{EMPNUM,\ SAL,\ TAX,\ MGRNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

**$EMP_1$**

| EMPNUM | NAME | SAL | TAX |
|---|---|---|---|
| 100 | Smith | 10000 | 1000 |

**$EMP_2$**

| EMPNUM | MGRNUM | DEPTNUM |
|---|---|---|
| 100 | 20 | 3 |

**$EMP_3$**

| EMPNUM | NAME | DEPTNUM |
|---|---|---|
| | | 15 |

**$EMP_4$**

| EMPNUM | SAL | TAX | MGRNUM |
|---|---|---|---|
| | | | |

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

# Effect of Update

$$EMP_1 = \mathbf{PJ}_{EMPNUM,\ NAME,\ SAL,\ TAX}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

$$EMP_2 = \mathbf{PJ}_{EMPNUM,\ MGRNUM,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

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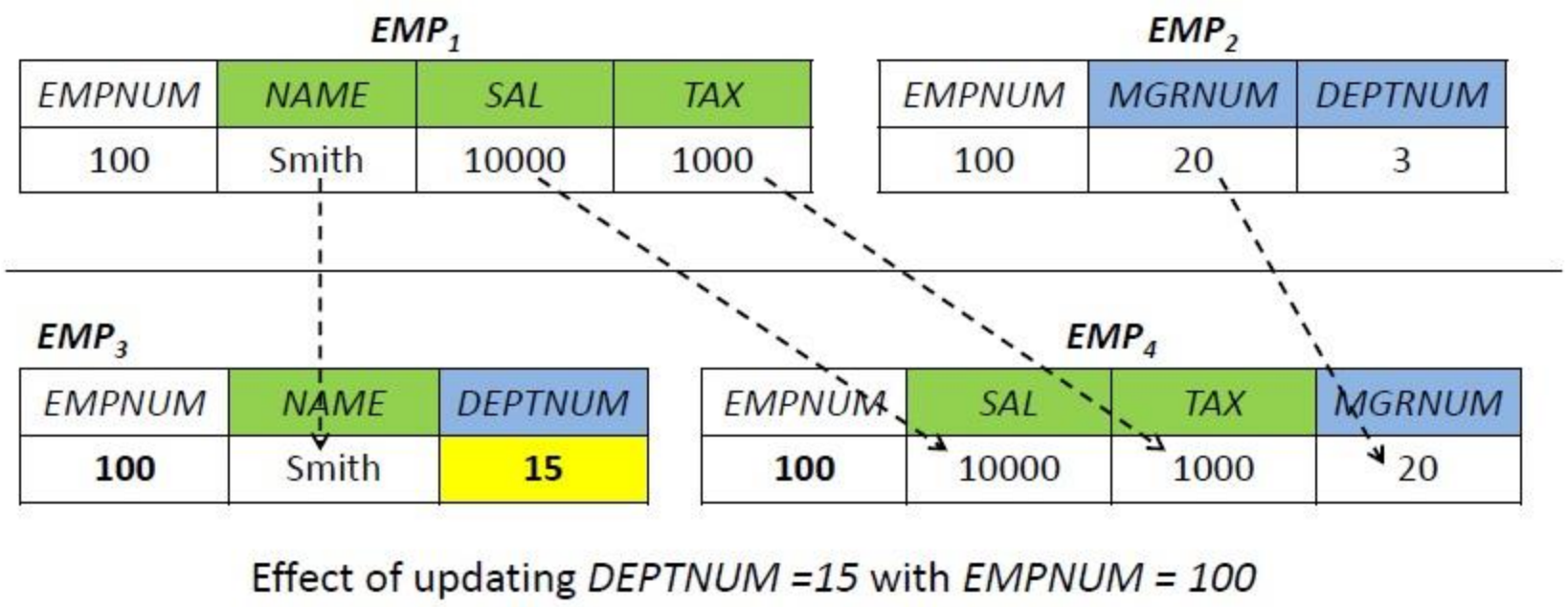
$$EMP_4 = \mathbf{PJ}_{EMPNUM,\ SAL,\ TAX,\ MGRNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$




Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

# Effect of Update

$$EMP_1 = \mathbf{PJ}_{EMPNUM,\ NAME,\ SAL,\ TAX}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

$$EMP_2 = \mathbf{PJ}_{EMPNUM,\ MGRNUM,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM \le 10}\ (EMP)$$

$$EMP_3 = \mathbf{PJ}_{EMPNUM,\ NAME,\ DEPTNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

$$EMP_4 = \mathbf{PJ}_{EMPNUM,\ SAL,\ TAX,\ MGRNUM}\ \mathbf{SL}_{DEPTNUM > 10}\ (EMP)$$

**$EMP_1$**

| EMPNUM | NAME | SAL | TAX |
|---|---|---|---|
| ~~100~~ | ~~Smith~~ | ~~10000~~ | ~~1000~~ |

**$EMP_2$**

| EMPNUM | MGRNUM | DEPTNUM |
|---|---|---|
| ~~100~~ | ~~20~~ | ~~3~~ |

**$EMP_3$**

| EMPNUM | NAME | DEPTNUM |
|---|---|---|
| 100 | Smith | 15 |

**$EMP_4$**

| EMPNUM | SAL | TAX | MGRNUM |
|---|---|---|---|
| 100 | 10000 | 1000 | 20 |

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

**Hints:** Use fragments. Use the *update sub-tree*. Follow the *effect of update*.

- ***Store*** the necessary record from $EMP_1$ and $EMP_2$ to temporary variables.
- ***Insert*** the records into $EMP_3$ and $EMP_4$ from the temporary variables.
- ***Delete*** the records from $EMP_1$ and $EMP_2$.

Select *NAME*, *SAL*, *TAX into $NAME*, *$SAL*, *$TAX*
from $EMP_1$
where *EMPNUM = 100;*
Select *MGRNUM into $MGRNUM*
from $EMP_2$
where *EMPNUM = 100;*

Insert into $EMP_3$ *(EMPNUM*, *NAME*, *DEPTNUM):*
(100, $NAME, 15);
Insert into $EMP_4$ *(EMPNUM*, *SAL*, *TAX*, *MGRNUM):*
(100, $SAL, $TAX, $MGRNUM);

Delete $EMP_1$ where *EMPNUM* = 100;
Delete $EMP_2$ where *EMPNUM* = 100;

# Analyzing Level – 3 transparency

**Hints:** Use fragments + locations. Follow the effect of update (like previous level), but this time locations will be considered.

- ***Store*** the necessary record from $EMP_1$ and $EMP_2$ from any of the corresponding sites to temporary variables.
- ***Insert*** the records into $EMP_3$ and $EMP_4$ at corresponding sites from the temporary variables.
- ***Delete*** the records from $EMP_1$ and $EMP_2$ at corresponding sites.

Select *NAME, SAL, TAX into $NAME, $SAL, $TAX*
from $EMP_1$ at site 1
where *EMPNUM = 100;*
Select *MGRNUM into $MGRNUM*
from $EMP_2$ at site 2
where *EMPNUM = 100;*

Insert into $EMP_3$ *(EMPNUM, NAME, DEPTNUM)*
at site 3 : (100, $NAME, 15);
Insert into $EMP_3$ *(EMPNUM, NAME, DEPTNUM)*
at site 7 : (100, $NAME, 15);
Insert into $EMP_4$ *(EMPNUM, SAL, TAX, MGRNUM)*
at site 4 : (100, $SAL, $TAX, $MGRNUM);
Insert into $EMP_4$ *(EMPNUM, SAL, TAX, MGRNUM)*
at site 8 : (100, $SAL, $TAX, $MGRNUM);

Delete $EMP_1$ at site 1 where *EMPNUM* = 100;
Delete $EMP_1$ at site 5 where *EMPNUM* = 100;
Delete $EMP_2$ at site 2 where *EMPNUM* = 100;
Delete $EMP_2$ at site 6 where *EMPNUM* = 100;

# Practice Problems/ Questions

a) For the example provided in the lecture slides, determine the effect of updating *DEPTNUM = 5* where *EMPNUM = 100 (assume, the record is initially found in* $EMP_3$ *and* $EMP_4$ *with DEPTNUM = 19).*

b) Text book:

- Exercise: 3.2 (a, b, c) and 3.3

c) Create your own scenario and analyze the different levels of distribution transparency for read-only and update application.