

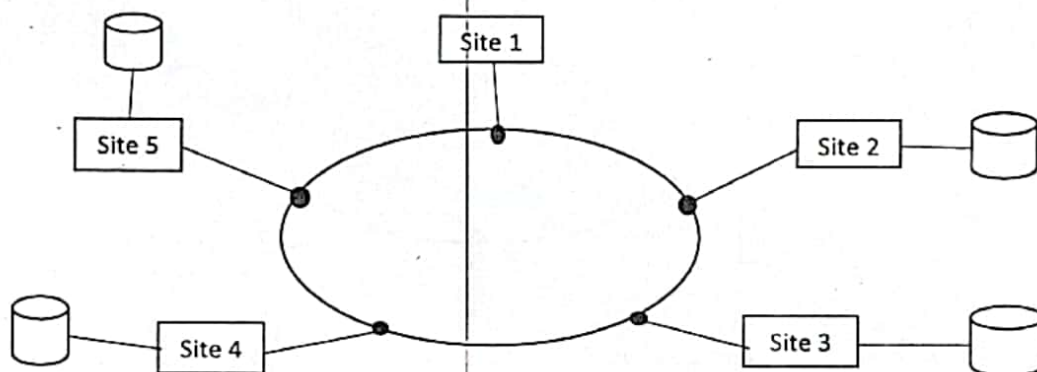
AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 01 | Marks 20 | Time: 40 Minutes | Set A

1. Which one of the following two distributed database environments lends itself more to centralized control and why? 5
 - *Distributed database on a geographically dispersed network*
 - *Distributed database on a local network*
2. Using an appropriate example prove that join is Cartesian product of two relations followed by a selection operation. 5
3. Do you think the system in the following figure is a distributed database system? Explain your answer. 5



4. Explain that in a point-to-point network, the cost of broadcasting a message to many sites is equivalent to sending many separate messages. 5

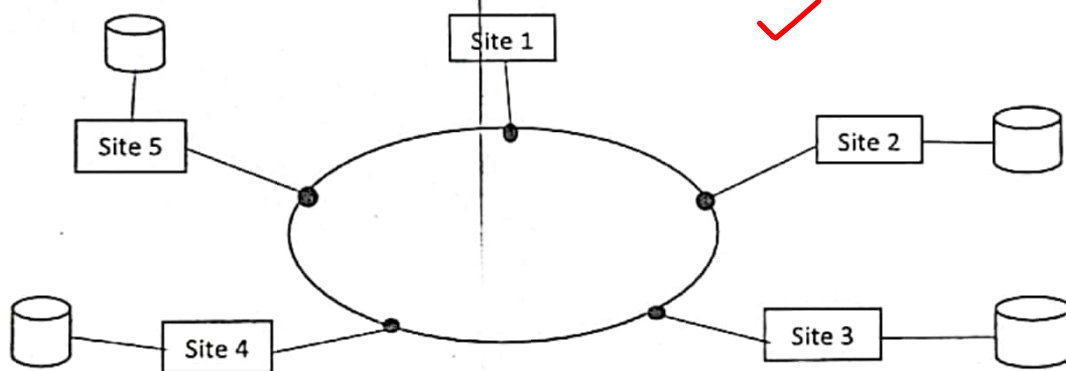
AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 01 | Marks 20 | Time: 40 Minutes | Set B

1. Describe a scenario where an organization needs to transfer centralized database into distributed database. 5
2. Using an appropriate example prove that semi join is join between two relations followed by a projection operation. 5
3. Do you think the system in the following figure is a distributed database system? Explain your answer. 5



4. Explain that in a point-to-point network, the cost of broadcasting a message to many sites is equivalent to sending many separate messages. 5

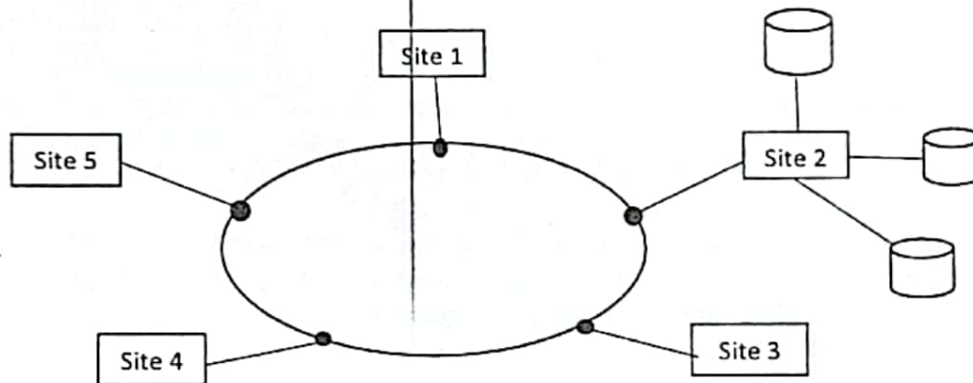
AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 01 | Marks 20 | Time: 40 Minutes | Set C

1. Explain with an example how communication overhead is reduced in case of distributed database systems. 5
2. Using an appropriate example prove that natural semi join is semi join between two relations followed by a projection operation. 5
3. Do you think the system in the following figure is a distributed database system? Explain your answer. 5



4.

What are some fundamental differences between a phone call and a session between two processes?

5

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Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 02 | Marks 20 | Time: 40 Minutes | Set A

1. Consider the following fragments ACCOUNT₁ and ACCOUNT₂.

ACCNO	ACCTYPE	BALANCE	BRANCH
3001	Savings	10,100	Dhaka
3002	Savings	15,020	Chittagong
3003	Savings	8,000	Chittagong
3004	Savings	12,000	Dhaka
3005	Savings	9,005	Khulna

ACCOUNT			
ACCNO	ACCTYPE	BALANCE	BRANCH
2001	Current	1,200	Dhaka
2002	Current	5,000	Khulna
2003	Current	4,080	Chittagong
2004	Current	2,000	Dhaka

Set of simple predicates Pr to obtain the fragments is given below.

P1: ACCTYPE = 'Savings'; P2: ACCTYPE = 'Current'; P3: BALANCE > 7,000; P4: BALANCE <= 7,000

Now, consider the following two applications.

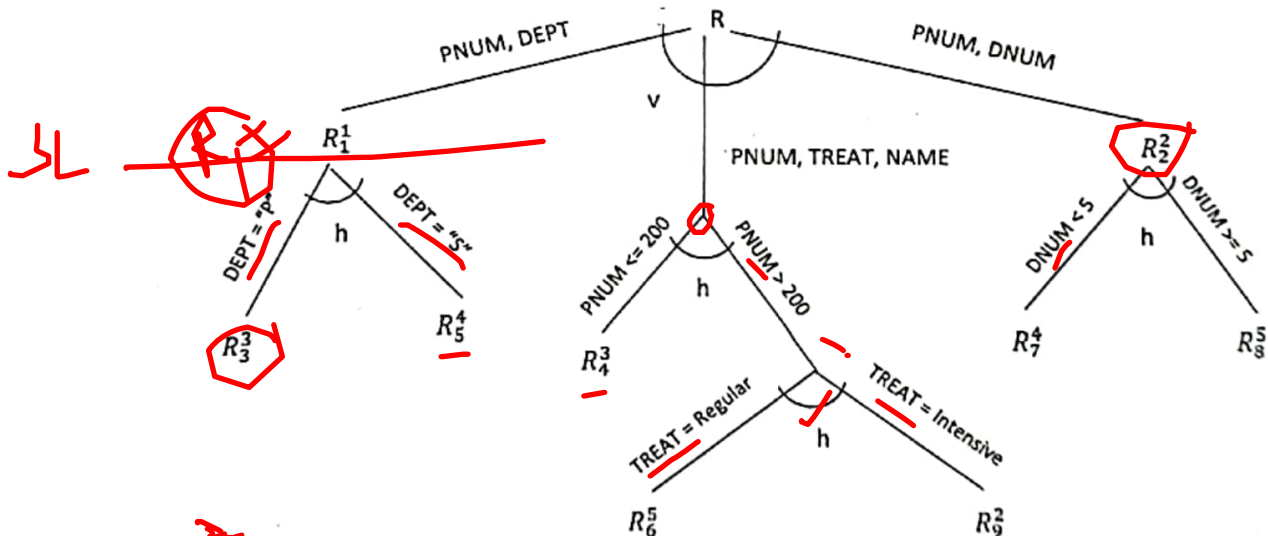
APP₁: select * from ACCOUNT₁ where BRANCH = 'Dhaka' or BRANCH = 'Chittagong' or BRANCH = 'Khulna'

APP₂: select * from *ACCOUNT₁* where *BALANCE* > 7,000

Determine whether $\mathcal{P}r$ is complete or not. Write down the reason behind your answer.

2. **a.** Consider the following global schema: $R(PNUM, NAME, DEPT, TREAT, DNUM)$

Write down the corresponding *Fragmentation schemata* for the following Fragmentation Tree.



- b. Write an application that does the necessary updates at *level 2* of distribution transparency to change PNUM 150 to 250.

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Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 02 | Marks 20 | Time: 40 Minutes | Set B

Consider the following global and fragmentation schemata.

Global Schema:

DOCTOR (DNUM, NAME, DEPT)
 PATIENT (PNUM, NAME, DEPT, TREAT, DNUM)
 CARE (PNUM, DRUG, QUAN)

Fragmentation schema:

DOCTOR₁ = SL_{DEPT} = "SURGERY" DOCTOR
 DOCTOR₂ = SL_{DEPT} = "PEDIATRICS" DOCTOR
 DOCTOR₃ = SL_{DEPT} ≠ "SURGERY" AND DEPT ≠ "PEDIATRICS" DOCTOR
 PATIENT₁ = SL_{DEPT} = "SURGERY" AND TREAT = "INTENSIVE" PATIENT
 PATIENT₂ = SL_{DEPT} = "SURGERY" AND TREAT ≠ "INTENSIVE" PATIENT
 PATIENT₃ = SL_{DEPT} ≠ "SURGERY" PATIENT
 CARE₁ = CARE SJ_{PNUM} = PNUM PATIENT₁
 CARE₂ = CARE SJ_{PNUM} = PNUM PATIENT₂
 CARE₃ = CARE SJ_{PNUM} = PNUM PATIENT₃

Applications:

APP1 = Select PNUM, TREAT from PATIENT where DEPT = "SURGERY";

APP2 = Update PATIENT set TREAT = 'Regular' where PNUM = 100;

APP3 = Select NAME from PATIENT;

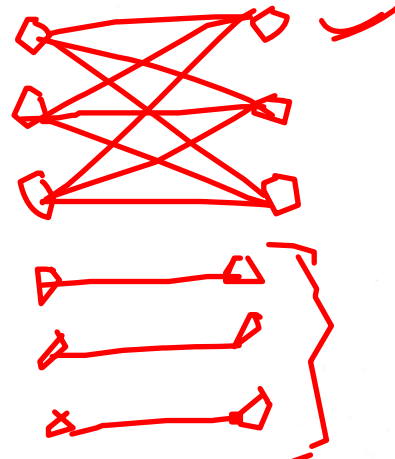
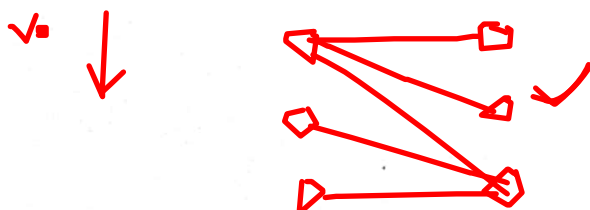
APP4 = Update PATIENT set NAME = "Z" where PNUM = 99;

Data for PATIENT relation:

PNUM	NAME	DEPT	TREAT	DNUM
99	A	Surgery	Intensive	10
100	B	Pediatrics	Intensive	11
101	C	Surgery	Regular	22
102	D	Medicine	Intensive	13
103	E	Surgery	Regular	24
104	F	Surgery	Intensive	15

- Determine the set of simple predicates P_r to obtain the relation PATIENT from its fragments. If APP₁, APP₂, APP₃ and APP₄ applications are issued, do you think the set P_r will maintain completeness and minimality property? If not, do necessary changes to make the set complete and minimal. Justify your answer. 10
- Suppose the patient having PNUM = 103 in PATIENT relation, wants to change the doctor number. So, the hospital changed his DNUM from 24 to 22. Write an application at level – 2 of distribution transparency to perform the necessary changes. 5
- Assume that a patient is always assigned to the same department as his or her doctor. Attribute DNUM and PNUM indicates Doctor Number and Patient Number respectively. Draw the join graphs of the following joins and classify them: 5

- DOCTOR $\bowtie_{DNUM = DNUM}$ PATIENT
- DOCTOR $\bowtie_{NAME = NAME}$ PATIENT
- DOCTOR $\bowtie_{DEPT = DEPT}$ PATIENT
- PATIENT \bowtie CARE



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Course No: CSE4125

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Spring 2021 | Quiz – 02 | Marks 20 | Time: 40 Minutes | Set C

1. Consider the following global relations.

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PATIENT (NUMBER, NAME, SSN, AMOUNT-DUE, DEPT, DOCTOR, MED-TREATMENT)

DEPARTMENT (DEPT, LOCATION, DIRECTOR)

STAFF (STAFFNUM, DIRECTOR, TASK)

Define their fragmentation as follows:

i. **DEPARTMENT** has horizontal fragmentation by *LOCATION*, with two locations: *New York* and *London*; each department is conducted by *DIRECTOR*.

ii. There are several staff members for each department, led by the department's director. **STAFF** has horizontal fragmentation derived from that of **DEPARTMENT** and a semi-join on the *DIRECTOR* attribute. Which assumption is required in order to assure completeness and disjointness?

iii. **PATIENT** has a mixed fragmentation: attributes *NUMBER, NAME, SSN*, and *AMOUNT-DUE* constitute a vertical fragment used for accounting purposes; attributes *NUMBER, NAME, DEPT, DOCTOR*, and *MED-TREATMENT* constitute a vertical fragment used for describing cares. This last fragment has a horizontal fragmentation derived from that of **DEPARTMENT** and a semi-join on the *DEPT* attribute. Which assumption is required in order to assure completeness and disjointness? Give also reconstruction of global relation from the fragments.

2. Consider the following fragments **ACCOUNT₁** and **ACCOUNT₂**.

10

ACCOUNT ₁			
ACCNO	ACCTYPE	BALANCE	BRANCH
3001	Savings	10,100	Dhaka
3002	Savings	15,020	Chittagong
3003	Savings	8,000	Chittagong
3004	Savings	12,000	Dhaka
3005	Savings	9,005	Khulna

ACCOUNT ₂			
ACCNO	ACCTYPE	BALANCE	BRANCH
2001	Current	1,200	Dhaka
2002	Current	5,000	Khulna
2003	Current	4,080	Chittagong
2004	Current	2,000	Dhaka

Set of simple predicates *Pr* to obtain the fragments is given below.

P1: *ACCTYPE* = 'Savings'

P2: *ACCTYPE* = 'Current'

P3: *BALANCE* > 7,000

P4: *BALANCE* ≤ 7,000

Now, consider the following two applications.

APP₁: select * from **ACCOUNT₁** where *BRANCH* = 'Dhaka' or *BRANCH* = 'Chittagong' or *BRANCH* = 'Khulna'

APP₂: select * from **ACCOUNT₁** where *BALANCE* > 7,000

Determine whether *Pr* is complete or not. Write down the reason behind your answer.

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Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 03 | Marks 10 | Time: 40 Minutes | Set A

1. Consider the following global relational schemata.

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

DEPT (ID, AREA, DEPTNUM, MGRNUM)

Corresponding fragmentation schemata:

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

$EMP_2 = \sigma_{SAL > 25K} EMP$

$DEPT_1 = \sigma_{AREA = \text{"North"}} DEPT$

$DEPT_2 = \sigma_{AREA = \text{"South"}} DEPT$

Also consider the following global query.

$PJ_{NAME, SAL, AGE, AREA}(((\sigma_{SAL > 25K} EMP \Join_{ID=ID} \sigma_{AREA = \text{"South"}} DEPT) \text{ DF } (\sigma_{SAL \leq 25K} EMP \Join_{ID=ID} \sigma_{AREA = \text{"South"}} DEPT))) \Join_{ID=ID} (\sigma_{AREA = \text{"South"}} (EMP \Join_{ID=ID} DEPT)))$

Now, answer the following questions.

- i. Draw the *operator tree*. [2]
- ii. Perform step-by-step transformations to simplify the operator tree, indicating which rule and criterion is applied at each step. [5]
- iii. Transform the simplified query into fragment query by applying canonical expression based on the given fragmentation schema. [2]
- iv. Write the equivalent query obtained from the simplified tree. [1]

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Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 03 | Marks 10 | Time: 40 Minutes | Set B

1. Consider the following global relational schemata.

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

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

Corresponding fragmentation schemata:

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

$EMP_2 = \sigma_{SAL > 25K} EMP$

$DEPT_1 = \sigma_{AREA = \text{"North"}} DEPT$

$DEPT_2 = \sigma_{AREA = \text{"South"}} DEPT$

Also consider the following global query.

$PJ_{NAME, SAL, AGE, AREA}(((\sigma_{SAL > 25K} EMP \Join_{ID=ID} \sigma_{AREA = \text{"South"}} DEPT) \Join_{SAL \leq 25K} EMP \Join_{ID=ID} \sigma_{AREA = \text{"South"}} DEPT)) \Join_{SAL > 25K} (EMP \Join_{ID=ID} DEPT)))$

Now, answer the following questions.

- i. Draw the operator tree. [2]
- ii. Perform step-by-step transformations to simplify the operator tree, indicating which rule and criterion is applied at each step. [5]
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Course No: CSE4125

Course Title: Distributed Database Systems

Spring 2021 | Quiz – 03 | Marks 10 | Time: 40 Minutes | Set C

1. Consider the following global relational schemata.

EMP (ID, NAME, SAL, AGE)

DEPT (ID, AREA, DEPTNUM, MGRNUM)

Corresponding fragmentation schemata:

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

$EMP_2 = \sigma_{SAL > 25K} EMP$

$DEPT_1 = \sigma_{MGRNUM \geq 375} DEPT$

$DEPT_2 = \sigma_{MGRNUM < 375} DEPT$

Also consider the following global query.

$\checkmark ((\sigma_{SAL > 25K} EMP \Join_{ID=ID} DEPT) \bowtie (\sigma_{AGE \leq 25} EMP \Join_{ID=ID} DEPT)) \Join (EMP \Join_{ID=ID} DEPT)$
 $\quad \quad \quad \bowtie (\sigma_{SAL > 25K \text{ AND } AGE > 25} EMP \Join_{ID=ID} DEPT)$

Now, answer the following questions.

- i. Draw the *operator tree*. [2]
- ii. Perform step-by-step transformations to simplify the operator tree, indicating which rule and criterion is applied at each step. [5]
- iii. Transform the simplified query into fragment query by applying canonical expression based on the given fragmentation schema. [2]
- iv. Write the equivalent query obtained from the simplified tree. [1]