Databases

Lecture 11
Exam Problems

I Choose the correct answer(s) for the following multiple choice questions. Each question has at least one correct answer.

1. In a SELECT query:
a. the SELECT clause can contain arithmetic expressions
b. according to the conceptual evaluation strategy, ORDER BY is evaluated before GROUP BY
c. HAVING can contain row-level qualification conditions
d. DISTINCT eliminates duplicates from the answer set
e. none of the above answers is correct.

2. The natural join operator R_1*R_2 in the relational algebra:

a. returns a relation whose schema contains only the attributes in R_1 that don't appear in R_2

b. returns a relation whose schema contains all the attributes in R_1 and R_2, with common attributes appearing only once

c. returns 2 relation instances

d. is not associative

e. none of the above answers is correct.

3. In the ANSI-SPARC architecture (for a database system), a database can have:
a. exactly one symbolic structure
b. several conceptual structures
c. several external structures
d. several physical structures
e. none of the above answers is correct.

4. Consider relation S[A, B, C, D, E, F, G, H] with:

- primary key {A, B, C}, no other candidate keys;
- functional dependencies that are known to hold over S: {F} → {H}, {C} → {E, G};
- no repeating attributes.

a. S is not 1NF

b. S is 2NF

c. S is not BCNF

d. S is 3NF

e. none of the above answers is correct.

5. The Buffer Manager in a DBMS:

a. automatically deletes indexes when necessary.

b. automatically creates indexes when necessary.

c. automatically defragments indexes when necessary.

d. automatically fragments indexes when necessary.

e. none of the above answers is correct.

6. Let α, β and γ be subsets of attributes in a relational schema. If $\alpha \rightarrow \beta$ and $\beta \rightarrow \gamma$, then by transitivity:

a. $\alpha \rightarrow \gamma$

b. $\gamma \rightarrow \alpha$

c. $\beta \rightarrow \alpha$

d. $\gamma \rightarrow \beta$

e. none of the above answers is correct.

7. Let RepairLog[RID, MechanicID, RollerCoasterID, RepairTime] be a table in a SQL Server database. RepairLog has 100.000 records and 2 indexes: a unique clustered index on RID and a non-clustered index on MechanicID without nonkey columns.

Consider the following query:

SELECT RID, MechanicID, RepairTime

FROM RepairLog

WHERE MechanicID = 7

If the execution plan contains an *Index Seek (NonClustered)*, it also contains a:

a. *Clustered Index Scan*

b. *Index Scan (NonClustered)*

c. *Key Lookup (Clustered)*

d. *Index Trick (NonClustered)*

e. none of the above answers is correct.

8-10. Consider the relational schema S[FK1, FK2, A, B, C, D, E], with primary key {FK1, FK2}. Answer questions 8-10 using the legal instance below:

FK1	FK2	A	B	C	D	E
1	1	a1	b1	c1	7	2
1	2	a_	b3	c1	5	2
1	3	a2	b1	c2	Null	2
2	1	a3	b3	c2	Null	100
2	2	a3	b3	c3	Null	100

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8. Consider queries Q_1 and Q_2:

Q_1:

SELECT *

FROM S s1 LEFT JOIN S s2 ON s1.FK1 = s2.E

Q_2:

SELECT DISTINCT *

FROM S s1 INNER JOIN S s2 ON s1.FK1 = s2.E

The cardinality of the answer set of Q_i is denoted by $|Q_i|$.

$|Q_1|$ - $|Q_2|$ is:

a. 0

b. 3

c. 10

d. 2

e. none of the above answers is correct.

FK1	FK2	A	B	C	D	E
1	1	a1	b1	c1	7	2
1	2	a_	b3	c1	5	2
1	3	a2	b1	c2	Null	2
2	1	a3	b3	c2	Null	100
2	2	a3	b3	c3	Null	100

S[FK1, FK2, A, B, C, D, E]

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9. Regarding the functional dependencies of S:

a. at least one of the following dependencies is not satisfied by the instance: {A} → {B}, {FK1, FK2} → {A, B}, {FK1} → {A}

b. by examining the instance, we can conclude that at least one of the following dependencies is specified on the schema S: {A} → {B}, {FK1} → {A, B}, {FK1} → {A}

c. at least two of the following dependencies are not satisfied by the instance: {FK2} → {A, B}, {A} → {E}, {A, B} → {E}, {FK1, FK2} → {E}

d. by examining the instance, we can conclude that at least two of the following dependencies are specified on the schema S: {FK2} → {A, B}, {A} → {E}, {A, B} → {E}, {B} → {C, E}

e. none of the above answers is correct.

FK1	FK2	A	B	C	D	E
1	1	a1	b1	c1	7	2
1	2	a_	b3	c1	5	2
1	3	a2	b1	c2	Null	2
2	1	a3	b3	c2	Null	100
2	2	a3	b3	c3	Null	100

S[FK1, FK2, A, B, C, D, E]

10. Consider queries Q_1 and Q_2:

Q_1:

SELECT FK2, FK1, COUNT(DISTINCT B)

FROM S

GROUP BY FK2, FK1

HAVING FK1 = 0

Q_2:

SELECT FK2, FK1, COUNT(C)

FROM S

GROUP BY FK2, FK1

HAVING MAX(E) < 0

The cardinality of the answer set of Q_i is denoted by $|Q_i|$.

->

FK1	FK2	A	B	C	D	E
1	1	a1	b1	c1	7	2
1	2	a_	b3	c1	5	2
1	3	a2	b1	c2	Null	2
2	1	a3	b3	c2	Null	100
2	2	a3	b3	c3	Null	100

S[FK1, FK2, A, B, C, D, E]

10.

$|Q_1| - |Q_2|$ is:

a. 0

b. 2

c. 1

d. -1

e. none of the above answers is correct.

FK1	FK2	A	B	C	D	E
1	1	a1	b1	c1	7	2
1	2	a_	b3	c1	5	2
1	3	a2	b1	c2	Null	2
2	1	a3	b3	c2	Null	100
2	2	a3	b3	c3	Null	100

S[FK1, FK2, A, B, C, D, E]

11. A unique index:

a. can contain duplicates

b. cannot contain duplicates

c. can be non-clustered

d. cannot be non-clustered

e. none of the above answers is correct.

12. For the relation R[A, B, C] below, consider the 3 possible projections on 2 attributes: AB[A, B], BC[B, C], AC[A, C]. How many extra records does AB * BC * AC contain (i.e., records that don't appear in R)?

A	B	C
a1	b2	c1
a1	b1	c2
a2	b1	c1

a. 0

b. 1

c. 2

d. 3

e. none of the above answers is correct.

13. The cross-product operator $R_1 \times R_2$ in the relational algebra:

a. returns a relation whose schema contains all the attributes in R_1 followed by all the attributes in R_2

b. returns a relation whose schema contains only the attributes in R_1

c. returns 3 relation instances

d. is associative

e. none of the above answers is correct.

II Answer the following questions / solve the following problems.

1. Rewrite the CREATE TABLE statements below such that the following restriction is enforced: one T1 entity can be associated with any number of T2 entities, and one T2 entity can be associated with at most one T1 entity. Don't add other SQL statements.

```
CREATE TABLE T1
  (IDT1 INT PRIMARY KEY,
  C1 VARCHAR(100))
CREATE TABLE T2
  (IDT2 INT PRIMARY KEY,
  C2 DATE)
```

2. Write the relational algebra expression below as a SQL query.

$$\pi_{\{A,B,C\}}((\pi_{\{A,B,ID\}}(\sigma_{M=70}(R))) \otimes_{ID=IDT1} (\pi_{\{C,IDT1\}}(\sigma_{N>5}(S))))$$

3-6. Consider the relational schema R[<u>RID</u>, A, B, C, D, E, F], with primary key {RID}. Answer questions 3-6 using the legal instance below:

RID	A	B	C	D	E	F
1	100	200	5	200	20	11
2	101	50	11	200	5	12
3	100	100	7	200	5	13
4	200	200	6	200	20	14
5	200	100	2	200	5	9
6	300	50	11	200	5	10

3. What's the result set returned by the following query? Write the tuples' values and the names of the columns.

SELECT r1.RID, r1.A + r2.A C2, r1.A * r2.A C3
FROM R r1 LEFT JOIN R r2 ON r1.RID = r2.RID
WHERE r1.A > ANY (SELECT B
                  FROM R
                  WHERE C < 10)

RID	A	B	C	D	E	F
1	100	200	5	200	20	11
2	101	50	11	200	5	12
3	100	100	7	200	5	13
4	200	200	6	200	20	14
5	200	100	2	200	5	9
6	300	50	11	200	5	10

R[RID, A, B, C, D, E, F]

4. Evaluate the expressions below. π doesn't eliminate duplicates. What's the cardinality of T?

$$S := \sigma_{F<13}(R)$$
$$T := \pi_{\{S.RID,S.A\}}(S \otimes_{S.D=R.D} R)$$

RID	A	B	C	D	E	F
1	100	200	5	200	20	11
2	101	50	11	200	5	12
3	100	100	7	200	5	13
4	200	200	6	200	20	14
5	200	100	2	200	5	9
6	300	50	11	200	5	10

R[RID, A, B, C, D, E, F]

5. What's the result set returned by the following query? Write the tuples' values and the names of the columns.

SELECT R.*
FROM
  (SELECT r1.RID, r2.A, r3.B
  FROM R r1 INNER JOIN R r2 ON r1.A = r2.B
    INNER JOIN R r3 ON r2.B > r3.D
  WHERE r1.F > 10) t
RIGHT JOIN R ON t.RID = R.RID

RID	A	B	C	D	E	F
1	100	200	5	200	20	11
2	101	50	11	200	5	12
3	100	100	7	200	5	13
4	200	200	6	200	20	14
5	200	100	2	200	5	9
6	300	50	11	200	5	10

R[RID, A, B, C, D, E, F]

6. Write all functional dependencies F such that:
- F is satisfied by the current instance of R;
- the dependent of F is {D};
- the determinant of F has a single column.

RID	A	B	C	D	E	F
1	100	200	5	200	20	11
2	101	50	11	200	5	12
3	100	100	7	200	5	13
4	200	200	6	200	20	14
5	200	100	2	200	5	9
6	300	50	11	200	5	10

R[RID, A, B, C, D, E, F]

7. Rewrite the expression below using only operators in the set $\{\sigma, \pi, \times, \cup, -\}$.

$$(R \otimes_{R.ID=S.RID} S) \cap (T \otimes_{T.ID=U.TID} U)$$