BDLF09

Written Exam (Preparation)

Duration: 4h

All documents allowed. You can write with a pencil.

No phone, no internet connections allowed.

All questions (across problems and within a problem) are independent. You can answer them in any order you want.

1. Quizz (40%)

Answer 8 of the following 10 questions.
For all questions you answer, you should justify your answer(s) in a sentence. In principle all questions can have multiple answers.

1) A superkey is
   a) the set of all attributes belonging to any candidate key
   b) the set of attributes that has a unique value for each tuple in the relation
   c) the primary key plus the secondary key
   d) a minimal set of attributes that has a unique value for each tuple of the relation

2) The allowed values for a foreign key are
   a) existing values from the referenced table
   b) existing values from the referenced table or NULL
   c) NULL
   d) any value from the domain of the corresponding attribute

3) A candidate key is
   a) an attribute that is potentially the key of a relation
   b) an attribute or a set of attributes that determines the values of all other attributes in the relation
   c) an attribute with a unique value for each tuple of a relation
   d) a minimal superkey
   e) a set of attributes referring to another relation in the database

4) If it is necessary to retrieve the values of an attribute for all tuples in a relation, which operator from the relational algebra should be used?
   a) equijoin
   b) select
   c) join
   d) project

5) What is the result of the project operation over attribute B applied on the given table R?

R

A	B	C
1	a	10
2	b	20
3	b	10
4	c	30
5	a	25
6	d	20

a) A table with 3 attributes (A, B, C) and 4 tuples
{<1,a,10>,<2,b,20>,<4,c,30>,<6,d,20>}
b) A table with 3 attributes (A, B, C) and 6 tuples:
{<1,a,10>,<2,b,20>,<3,b,10>,<4,c,30>,<5,a,25>,<6,d,20>}
c) A table with 2 attributes (A, B) and 6 tuples
{<1,a>,<2,b>,<3,b>,<4,c>,<5,a>,<6,d>}
d) A table with 2 attribute (A, B) and 4 tuples
{<1,a>,<2,b>,<4,c>,<5,a>,<6,d>}
e) A table with one attribute (B) and 4 tuples
{<a>,<b>, <c>, <d>}
f) A table with one attribute (B) and 6 tuples
{<a>,< b>, <b>, <c>, <a>, <d>}

6) Two tables are given: STUDENT(StudNo,Name,Department) and GRADES(StudNo,Course,Grade). What is the effect of the following relational algebra query:πNAME((πCOURSE, STUDNO (GRADES) ÷ πCOURSE (GRADES)) join on StudNo STUDENT) where join on StudNo is the equijoin on the attribute StudNo.

a) List students who have passed at least one course.
b) List students who have passed some courses.
c) List students who have passed no courses.
d) List students who have not passed all courses.
e) List students who have passed all courses.

7) Two tables are given: STUDENT(StudNo,Name,Department) and GRADES(StudNo,Course,Grade). Which of the given SQL statements is equivalent to the following relational algebra query:
πNAME((πCOURSE, STUDNO (GRADES) ÷ πCOURSE (GRADES)) * STUDENT)

a)
```
SELECT name
FROM student
WHERE NOT EXISTS
((SELECT course FROM grades)
EXCEPT
(SELECT course FROM grades
  WHERE student.studno=grades.studno));
```

b)
```
SELECT name
FROM student
WHERE NOT EXISTS
(SELECT * FROM grades
```

WHERE student.studentno=grades.studno);

c) SELECT name
FROM student
WHERE NOT EXISTS
((SELECT course FROM grades)
EXCEPT
(SELECT grade FROM grades
WHERE student.studno=grades.studno));

d) SELECT name
FROM student
WHERE EXISTS
(SELECT course FROM grades
WHERE NOT EXISTS
(SELECT * FROM grades
WHERE student.studentno=grades.studno));

e) SELECT name
FROM student
WHERE NOT EXISTS
(SELECT course FROM grades
WHERE NOT EXISTS (SELECT *
FROM grades
WHERE student.studentno=grades.studno));

f) SELECT name
FROM student
WHERE EXISTS
(SELECT * FROM grades
WHERE student.studentno=grades.studno);

8) Is this a well formed XML document?

```
<?xml version="1.0"?>
<note>
<to age="29">Tove</to>
<from>Jani</from>
</note>
```

a) Yes
b) No

9) Is this a well formed XML document?

```
<?xml version="1.0"?>
<note>
<to age="29"/>
<from>Jani</from>
</note>
```

a) Yes
b) No

10) Consider the relation account(<u>id int</u>, balance int) and two transactions
T1: find the average balance over all accounts
T2: increase the balance by 5% for id equals 45

What statements are true:

a) The order in which T1 and T2 does not impact the result of the average computed in T1
b) T1 and T2 can be serialized
c) T1 and T2 are conflicting

2. Modelling, Relational Model, Query Languages (60%)

Consider the following relational schema (the keys are underlined):

movie(title, description, director)
    a movie has a title, a description and a director (the person who shot the movie).
screen (name, time, *title*)
    theatre screen defined by its name and the title of the movie playing at a given time.
see (spectator, *title*)
    a relationship between a spectator and the movie she has seen
play (actor, *title*)
    a relationship between an actor and the movie she has played in
produce (producer, *title*)
    a relationship between a producer and the movie he has produced
like (fan, *title*)
    a relationship between a fan and the movie she liked

Question 1 (10%):
1. Give the UML diagram of a conceptual model that corresponds to this relational schema.

Question 2 (10%): We add the following constraints to the relational schema:

1. If a movie is deleted, then all references to that movie should be deleted from the database
2. A director cannot produce the film she directs.

Write these constraints in SQL (note that you might want to introduce SQL create table statements).

Question 3 (5%): Express the following queries in english or danish

1. Π_{actor} (**play** $\bowtie$ ($\sigma_{director=Fly}$ (**movie**)))
2. {S.name | screen(S) and ü $\exists$ L $\in$ like (L.title = S.title and L.fan = "Philippe"}
3. SELECT P.producer
   FROM produce P
   WHERE NOT EXISTS (SELECT *
                     FROM like L
                     WHERE L.title = P.title
                       AND L.fan = "Philippe")

Question 4 (25%): Formulate the following queries in relational algebra and SQL

1. Which actors are also producer?
2. Which fans like movies they have not seen?
3. Which movies are not shown in any theatre?
4. Who are the producers that only see the movies they produce? (hint: how about those producers who never see a movie?)

Question 5 (10%): Assume that the movie table contains two tuples ("Schreck", "animation",

”Chris Miller”) and (”The incredibles”, ”animation”, ”Brad Bird”). Now assume that you want to transmit these tuples to another system using XML.

1. Give a well-formed XML document that contains both these tuples
2. Using Xpath, write the following query ”What is the title of animation movies”?