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IDS 521 (Advanced Database Management Systems) Saturday February 21, 2015. Prof. Ali Tafti

      DO NOT OPEN THIS EXAM,
              Until you are instructed to do so.

Before you begin the exam, please make sure that your exam booklet contains pages 1 through 13 (including this cover sheet, pages are double-sided). Please sign this cover sheet and the top of *every page of this exam booklet*. You will need to do this in order to get credit for this exam. When you are done, you will need to submit the exam question booklet along with your answer sheet. You may mark up the question booklet.

The length of the exam is timed at: 90 minutes.

Use of mobile telephony devices (smartphones) or tablet computers, <u>for any reason ,</u> are prohibited. During the exam, conversation with anyone other than proctors is prohibited.

You will need a #2 pencil to fill the scantron answer sheet.

Statement:

I acknowledge this is a *closed book, closed notes, closed computer exam.* In submitting this exam, I attest to be fully compliant with academic integrity policies of the UIC College of Business. I have not intentionally used or attempted to use unauthorized information, people, or study aids in any academic exercise during the exam. I have not and will not provide or receive from another person, any kind of unauthorized assistance on this examination.

Communicating with anyone other than a proctor during the exam will result in an automatic grade of zero.

Please Print Your name:

Your signature:

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For all multiple choice questions, please select the single best answer that applies. Please read all choices carefully before answering. For some questions, you will need to refer to the Sakila schema provided at the end of this booklet.

USE THIS INFORMATION TO ANSWER QUESTIONS 1 through 4:

1) Consider a table with information about student class schedules in a secondary school, with the following columns:

D Day of week (1 through 7)
P Period of day (1 through 6)
C Classroom
T Teacher
S Student id
L Lesson

Suppose we have the following dependencies:

    i.   {Student id, Day of week, Period of day} → {Lesson, Classroom, Teacher}
    ii.   {Day of week, Period of day, Classroom} → {Lesson, Teacher}
    iii.   {Student id, Lesson} → {Teacher, Day of week, Period of day, Classroom}
    iv.   {Teacher, Day of week, Period of day} → {Classroom, Lesson}

Question: Which of the following is a candidate key for the above schema?

a) {Student id, Lesson}
b) {Teacher, Lesson}
c) {Student id, Day of week, Period of day}
d) All of the above
e) a & c only

2) With the same functional dependencies as in the prior question, which is the strictest normal form that this schema is in?

a) First normal form.
b) Second normal form.
c) Third normal form.
d) Boyce-Codd normal form.
e) None of the above.

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3) Suppose the schema is then decomposed into the following two tables below. With the same functional dependencies as in the prior question, which is the strictest normal form that both tables in this schema are now in?

  i. {Student id, Lesson, Day of week, Period of day}
  ii. {Classroom, Teacher, Day of week, Period of day, Lesson}

a) First normal form.
b) Second normal form.
c) Third normal form.
d) Boyce-Codd normal form.
e) None of the above.

4) Suppose the schema is instead decomposed into the following two tables below. With the same functional dependencies as in the prior question, which is the strictest normal form that both tables in this schema are now in?

  i. {Student id, Day of week, Period of day, Classroom}
  ii. {Classroom, Teacher, Day of week, Period of day, Lesson}

a) First normal form.
b) Second normal form.
c) Third normal form.
d) Boyce-Codd normal form.
e) None of the above.

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5) Consider the following table that keeps track of inspection status for vehicles in each state government in the United States. Please note that VIN stands for Vehicle Identification Number.

Table: VIN, State Code, State Name, Status

Suppose we have the following dependencies:

   i.   {VIN, State Code} → Status
   ii. State Code → State Name,
   iii. State Name → State Code

Question: Which of the following is a candidate key?

a) {VIN, State Code}
b) {VIN, State Name}
c) {VIN, State Code, State Name}
d) All of the above
e) a & b only

6) Consider the same table above as in the prior question. Which is the strictest normal form that this schema is in?

a) First normal form.
b) Second normal form.
c) Third normal form.
d) Boyce-Codd normal form.
e) None of the above.

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7) Consider a table with the following columns: {city, service, vendor}. It has the following functional dependencies:

      i.   {city, service} → vendor
     ii.   vendor → service

Which of the following is a candidate key?

a) {city}
b) {city, vendor}
c) {vendor, service}
d) only b & c are candidate keys
e) only a & c are candidate keys

8) For the schema in the prior question, what is the strictest normal form that it is in?

a) First normal form.
b) Second normal form.
c) Third normal form.
d) Boyce-Codd normal form.
e) None of the above.

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9) Customers who are currently renting at least one item can be identified because they have a pending rental with no return date (return_date is null). Which of the following queries returns a unique list of customers who have made rentals in the past and returned all of them, so that none of them are pending? (Please refer to the Sakila schema.)

a) Select first_name, last_name from customer

where customer_id not in

(Select customer.customer_id from customer

left join rental on rental.customer_id = customer.customer_id

where return_date is null);

b) Select first_name, last_name from customer

where customer_id not in

(Select customer.customer_id from customer

right join rental on rental.customer_id = customer.customer_id

where return_date is null);

c) Select first_name, last_name from customer

where customer_id not in

(Select customer.customer_id from customer, rental

where customer.customer_id = rental.customer_id and return_date is null);

d) All of the above.

e) None of the above.

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10) Please describe the result set for this query (refer to the Sakila schema):

SELECT outer_cust.last_name, outer_cust.first_name from customer outer_cust
        where exists
                (select null from rental r,
                        inventory i,
                        category cg,
                        film_category fc,
                        customer inner_cust
where cg.name = 'Drama'
        and inner_cust.customer_id = outer_cust.customer_id
        and inner_cust.customer_id = r.customer_id
        and r.inventory_id = i.inventory_id
        and i.film_id = fc.film_id
        and fc.category_id = cg.category_id);

a) Obtain a unique list of customers who have NOT rented dramas (category name is 'Drama'), i.e. with no duplicate tuples.

b) Obtain a unique list of customers who have rented dramas (category name is 'Drama'), i.e. with no duplicate tuples.

c) Obtain a list of customers who have rented dramas (category name is 'Drama'), with one entry for each time a customer rented a drama.

d) Obtain a list of customers who have rented only dramas (category name is 'Drama'), or else, have not rented any movies at all.

e) Obtain a list of customers who have rented more than one dramas (category name is 'Drama').

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USE THIS INFORMATION TO ANSWER QUESTIONS 11, 12 and 13:

The following columns in the Customer table are indexed (using standard Btree+ indexes): customer_id, store_id, address_id, last_name.

Suppose the Customer table has 600 entries.

11) How many tuples are scanned to perform the following query:

Select * from Customer where last_name like 'John%';

   a) The number of tuples in which the left hand side of the last_name field begins with John.
   b) One.
   c) The number of tuples in which the last_name is John.
   d) All of the rows in the customer table.
   e) None of the above.

12) How many tuples are scanned to perform the following query:

Select * from Customer where last_name like '%John%';

   a) The number of tuples in which the right hand side of the last_name field begins with John.
   b) The number of tuples in which last_name field contains the substring John.
   c) One row.
   d) All of the rows in the Customer table.
   e) None of the above.

13) How many tuples are scanned to perform the following query:

Select * from Customer where first_name like 'John%'

   a) The number of tuples in which the left hand side of the first_name field begins with John.
   b) One.
   c) The number of tuples in which the first_name is John.
   d) All of the rows in the Customer table.
   e) None of the above.

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USE THIS INFORMATION TO ANSWER QUESTIONS 14, 15, and 16:

Consider the following partial schema in the Enrollments database, listing each table and its columns in brackets:

Student {*sno, sName, age*}
Course {*cno, title, credits*}
Enroll {*sno, cno*}
Professor {*lname, dept, salary, age*}
Teach {*lname, cno*}

14) Describe the result set returned by this query:

Select * From Course where cno in
(Select t1.cno from Teach t1, Teach t2
Where t1.lname > t2.lname and t1.cno = t2.cno)

   a) The cartesian product representing every possible combination of teachers and
       courses.
   b) All courses taught by the professor whose name appears last in the
       alphabetically ordered list of professors.
   c) Courses taught by two or more professors.
   d) This query generally returns no results.
   e) None of the above.

15) Describe the result set returned by this query:

Select lname from Professor where lname not in (
        Select lname from Course c, Professor p where (p.lname, c.cno) not in
                (Select lname, cno from Teach))

   a) Professors who teach all courses.
   b) Professors who teach no courses.
   c) All professors who have taught a course.
   d) This query generally returns no results.
   e) None of the above.

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16) Describe the result set returned by this query:

Select * from Professor where lname not in
(
        Select p3.lname from Professor p1, Professor p2, Professor p3
        Where p1.salary > p2.salary and p2.salary > p3.salary

)

a) The two highest paid professors.
b) The two lowest paid professors.
c) The second highest paid professor.
d) The third lowest paid professor.
e) None of the above.

17) (Please refer to the Sakila schema at the back of the question booklet.) Consider queries i and ii below; the difference between them is in **bold**:

i)
Select * from customer where (first_name, last_name) in (
Select a.first_name, a.last_name from staff s
right join actor a on a.first_name = s.first_name
and a.last_name = s.last_name
);

ii)
Select * from customer where (first_name, last_name) in (
Select a.first_name, a.last_name from staff s
left join actor a on a.first_name = s.first_name
and a.last_name = s.last_name
);

Which of the following is true:

a) The sub-query in query (i) returns the first name and last name of all actors. The outer query in (i) returns all of the customers whose combination of first name and last name matches the sub-query results.
b) Query (i) generally returns no tuples.
c) Query (ii) generally returns no tuples.
d) a & c only
e) b & c only

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18) Consider the following query to retrieve first names and last names in the staff table:

Select first_name, last_name from staff;

Suppose it returns the following tuples from the staff table:

first_name	last_name
Mike	Hillyer
Jon	Stephens
Samantha	Gibbons

Which names will be returned by the following query:

Select * from staff s where s.first_name in (
'Mike', 'Ali', null);

   a) Mike
   b) Generally, no tuples are returned.
   c) Samantha
   d) Ali
   e) a & d only

19) A marketing campaign will begin by sending promotion offers to addresses that are not currently assigned to any customer. Which query shows only the list of addresses that have no customer? (Please refer to the Sakila schema at the end of this booklet.)

a)
Select address from customer
right join address on customer.address_id = address.address_id
where customer_id is null;

 b)
Select address from customer
left join address on customer.address_id = address.address_id
where customer_id is null;

c)
Select address from address
right join customer on customer.address_id = address.address_id
where customer_id is null;

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d)
Select address from address
left join customer on customer.address_id = address.address_id
where customer_id is null;

e) a & d only

20) Which of the following queries returns a list of customers who have never made rentals?   (Please refer to the Sakila schema at the end of this booklet.)

a)
Select customer.customer_id, first_name, last_name
from rental, customer
where rental_id is null
and customer.customer_id = rental.customer_id;

b)
Select customer.customer_id, first_name, last_name from customer
right join rental on rental.customer_id = customer.customer_id
where rental_id is null;

c)
Select customer.customer_id, first_name, last_name from rental
left join customer on rental.customer_id = customer.customer_id
where rental_id is null;

d)
Select customer.customer_id, first_name, last_name from customer
left join rental on rental.customer_id = customer.customer_id
where rental_id is null;

e) All except a.