CSCI 585 Fall 2015 Test 1

2015-10-08

Last Name: _____

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1. (4 marks) Explain the difference between logical and physical data independence.

2. (15 marks) Given the relations shown below, show the results of the following relational operations. List all tuples and the column names in the result.

S

S#	city
S1	Paris
S2	Berne
S3	Oslo
S4	.null.
S5	Paris

P

P#	city
P1	Paris
P2	Berne
P3	Rome
P4	.null.
P5	.null.

J

J#	city
J1	Paris
J2	Rome
J3	Oslo
J4	.null.
J5	Rome

a) (2 marks) The projection of S on city
b) (2 marks) The union of result (a) and the projection of P on city
c) (2 marks) The set difference of result (a) and the projection of P on city (in that order)
d) (2 marks) The intersection of result (c) and the projection of J on city
e) (3 marks) The natural join of P and J
f) (4 marks) The full outer natural join of S and P.

USE THE NEXT PAGE TO ANSWER THIS QUESTION.

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3. (12 marks) Suppose you are given the following schema, which is used by an airline:

employee (<u>emp_id</u>, name, salary)
flights (<u>flight_no</u>, from, to, distance, depart_time, arrival_time)
aircraft (<u>aircraft_id</u>, manufacturer, model, range)
certified (<u>emp_id</u>, <u>aircraft_id</u>)

Different flights between the same pair of cities may have different distance and duration.
The *certified* relation indicates which employee(s) is/are certified to fly which aircraft. For simplicity, do not consider complicated cases beyond the scope expressed above, e.g. do not complicate the problem by imagining connection flights or etc..
For each of the following expressions, give the equivalent SQL statement.

a) (3 marks) Find the flight numbers of all the flights originating from Vancouver which depart after "13:00".

b) (4 marks) Find the names of employees who are certified to fly aircraft manufactured by 'Boeing'.

c) (5 marks) List the aircraft ids of aircraft that have sufficient range to cover the distance from Vancouver to Tokyo (using any existing flight plan / route).

4. (12 marks) Suppose you are given the following schema used by a library:

authors (author_id, last_name, first_name)
books (book_id, title, num_pages, author_id)
branches (branch_id, branch_name, address, phone_no)
copies (copy_id, branch_id, book_id, cost)
loans (loan_id, copy_id, borrower_id, borrow_date, due_date)
borrowers (borrower_id, name, member_since)

For each of the following SQL statements, explain, in plain English, what the statement is attempting to accomplish:

a) (2 marks)

```
SELECT title FROM books B
WHERE (SELECT COUNT(*)
       FROM copy C
       WHERE C.book_id = B.book_id) < 10
```

b) (4 marks)

```
SELECT name FROM borrowers P
WHERE member_since >= 1998 AND NOT EXISTS (
   SELECT * FROM books B WHERE NOT EXISTS (
     SELECT * FROM copies C, loans L
     WHERE B.book_id = C.book_id AND C.copy_id =
L.copy_id
       AND L.borrower_id = P.borrower_id))
```

c) (6 marks)

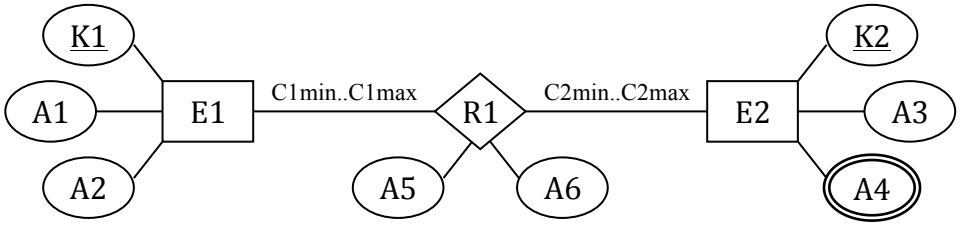
```
SELECT L.branch_id, L.name, AVERAGE(num_pages) pagecount
FROM branches L, books B
WHERE EXISTS (SELECT * FROM copies C
              WHERE L.branch_id = C.branch_id
                AND C.book_id = B.book_id)
GROUP BY L.branch_id
ORDER BY pagecount
```

5. (15 marks) Consider the business rules below, describing a database of athletes, sports and teams. ***Using Chen's notation***, draw an ER diagram that encodes these business rules. *Give meaningful, descriptive names for entities, attributes, and relationships. Clearly mark all key and participation constraints*. For consistency, **DO NOT** use other notations, e.g. the cardinality of Crow's feet notation.

   - An athlete is described by a name and a date of birth (dob), and no two athletes have the same combination of name and dob.
   - A team is described by its name, and no two teams have the same name.
   - A sport is described by its name and contains information about whether this is an Olympic sport or not. All sports have different names.
   - Each athlete plays exactly one sport, and belongs to at most one team.
   - Each team is made up of at least two athletes.

6. (15 marks) Alice has a large DVD movie collection. Her friends like to borrow her DVD's, and she needs a way to keep track of who has what. She maintains a list of friends, identified by unique FID's (friend identifiers) and a list of DVD's, identified by DVDID's (DVD identifiers). With each friend is the name and the all-important telephone number which she can call to get the DVD back. With each DVD is the title and names of actors starring in it. Whenever a friend borrows a DVD, Alice will enter that fact into her database along with the date borrowed. Whenever the DVD gets returned, that fact, too, gets noted along with the date returned. Alice wants to keep a complete history of her friends' borrowing habits so that she can ask favors of the heavy borrowers (or perhaps refuse to make further loans to those who habitually don't return them quickly).

   Below is an E-R diagram for a database to help Alice out. Provide appropriate names for the entities, keys, attributes, and relationships, as well as values for the cardinality constraints.



E1: _____ K1 : _____

A1 : _____ A2 : _____

E2 _____ K2 : _____

A3 : _____ A4 : _____

R1 : _____

A5 : _____ A6 : _____

C1min : _____ C1max : _____

C2min : _____ C2max : _____

7. (12 marks) Assume we have the following relation, which is not normalized:

   Persons *(SSN, Name, StreetAddr, City, State, Zip, Phone, Employer, EmployerHQAddr)*

a. (1 marks) What would be the likely primary key attribute(s) of the above unnormalized relation?

b. (9 marks) List all non-trivial functional dependencies.

c. (2 marks) If this relation were used as defined (without normalization), describe an update anomaly that could arise.

8. (15 marks) You are given the following un-normalized table.
Show the (a) 1st, (b) 2nd and (c) 3rd normal forms for the table. You **DO NOT** need to show what the data for the resulting tables ends up being (although you do need to show the final schema). You also are not required to show your work.

StudentID	AdvisorID	AdvName	AdvRoom	RegisteredClasses	
123	234A	James	555	102-8	104-9
124	456B	Smith	467	209-2	102-8
125	234A	James	555	104-9	202-4

a) 1NF:

b) 2NF:

c) 3NF:

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