CS585   Fall '15   Test 1   Sample Solutions

1.

Logical data independence means that changes at the logical/conceptual level, i.e. tables, columns, rows) should have no impact on the external level, i.e. users and applications that access the database. For example, adding tables, columns or rows to the database should not require existing applications and queries to change.

Whereas physical data independence requires that changes at the physical level, i.e. storage media, data structures, should have no impact at higher levels on the applications that consume the database. For example, changing the index of a table from hash index to b-tree index should not require existing applications and queries to change.

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Side Note: Recall from Codd's rules:

Rule 8: Application programs and terminal activities remain logically unimpaired whenever any changes are made in either storage representations or access methods.

Rule 9: Application programs and terminal activities remain logically unimpaired when information-preserving changes of any kind that theoretically permit non-impairment are made to the base tables.

2.

a)

city
Paris
Berne
Oslo

b)

city
Paris
Berne
Oslo
Rome

c)

city
Oslo

d)

city
Oslo

e)

P#	city	J#
P1	Paris	J1
P3	Rome	J2
P3	Rome	J5

f)

S#	city	P#
S1	Paris	P1
S2	Berne	P2
S3	Oslo	.null.
S5	Paris	P1
.null.	Rome	P3

3.

a)

```
SELECT flight_no
FROM flights
WHERE from_city = 'Vancouver'
  AND depart_time > '13:00'
```

b)

```
SELECT name
FROM aircraft A, certified C, employee E
WHERE A.aircraft_id = C.aircraft_id
  AND C.emp_id = E.emp_id
  AND A.manufacturer = 'Boeing'
```

c)

```
SELECT aircraft_id FROM aircraft
WHERE range > ANY (
    SELECT distance FROM flights
    WHERE from_city = 'Vancouver'
      AND to_city = 'Tokyo'
)
```

4.

a)

Find the titles of books for which there are less than 10 copies (in total across all branches).

b)

Find the names of borrowers who have been members since 1998, and who have borrowed every book before (or: for which there is no book that they have not borrowed before).

c)

List every branch. For each branch, give its ID, name, and the average number of pages across all books available in that branch (not counting multiple copies). Sort the results in increasing order of the average page count.

5.
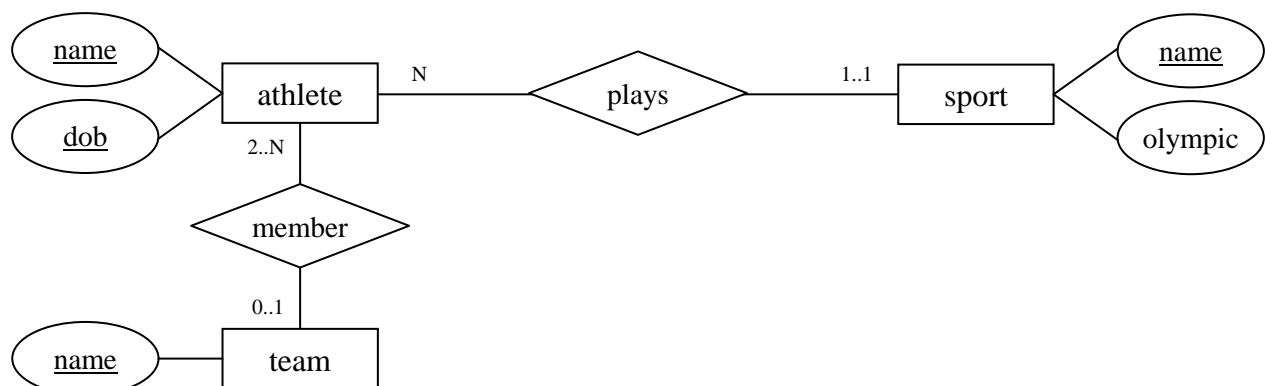
6.

E1: Friend	K1: FID	A1, A2: name, telephone	
E2: DVD	K2: DVDID	A3: title	A4: actors

R1: borrows   A5, A6: date_borrowed, date_returned

C1min: 0	C1max: N	C2min: 0	C2max: N

7.

a)

SSN

b)

SSN → Name
SSN → StreetAddr
SSN → City
SSN → State
SSN → Zip
SSN → Phone
SSN → Employer
SSN → EmployerHQAddr

{StreetAddr, City, State} → Zip

Zip → City
Zip → State

Employer → EmployerHQAddr

c)

A change is made to the employer of a person, but forgetting to change the corresponding employer HQ address to that of the new employer

or

There may be multiple people employed by the same company (employer). When the HQ address of a company is changed, the employer HQ address value is updated for some people but not others due to some careless omission.

8. * Data has been shown here for clarity, although not required by the question.

a) 1NF:

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

b) 2NF:

StudentID	AdvisorID	AdvName	AdvRoom
123	234A	James	555
124	456B	Smith	467
125	234A	James	555

StudentID	Class
123	102-8
123	104-9
124	209-2
124	102-8
125	104-9
125	202-4

c) 3NF:

StudentID	AdvisorID
123	234A
124	456B
125	234A

AdvisorID	AdvName	AdvRoom
234A	James	555
456B	Smith	467

StudentID	Class
123	102-8
123	104-9
124	209-2
124	102-8
125	104-9
125	202-4