PDPM IIITDM JABALPUR
CS203 DATABASE DESIGN AND MANAGEMENT
QUIZ 1 - SOLUTION

1. [1] The database environment has all of the following components except:
   (a). Users (b). Separate files
   (c). Database. (d). Database administrator

   Answer: (b)

2. [2] Which of the following is/are true for relational database?
   (a). Number of rows is cardinality, number of columns is degree
   (b). Tuple is an entity, column is a relation
   (c). Relation is an entity, tuple is a relationship
   (d). Row is a tuple, column is an attribute

   Answer: (a), (d)

3. [2] Given the basic ER and relational models, which of the following is/are INCORRECT?

   (a). An attribute of an entity can have more than one value
   (b). An attribute of an entity can be composite
   (c). In a row of a relational table, an attribute can have more than one value
   (d). In a row of a relational table, an attribute can have exactly one value or a NULL value

   Answer: (c)
   Explanation: The term 'entity' belongs to ER model and the term 'relational table' belongs to relational model. (a) and (b) both are true. ER model supports both multivalued and composite attributes. (c) is false and (d) is true. In Relation model, an entry in relational table can have exactly one value or a NULL.

4. [2] Which of the following statements is/are true
   (a). Each superkey is a superset of some candidate key.
   (b). Each primary key is also a candidate key, but there may be candidate keys that are not primary keys.

   Answer: Both 1 and 2 are true

5. [2] Consider a relational table with a single record for each registered student with the following attributes.

   1. Registration_Number: Unique registration number of each registered student
   2. UID: Unique Identity number, unique at the national level for each citizen
   3. BankAccount_Number: Unique account number at the bank. A student can have multiple accounts or joint accounts. This attributes stores the primary account number
   4. Name: Name of the Student
   5. Hostel_Room: Room number of the hostel

   Which of the following options is/are INCORRECT?
   (a). BankAccount_Number is a candidate key

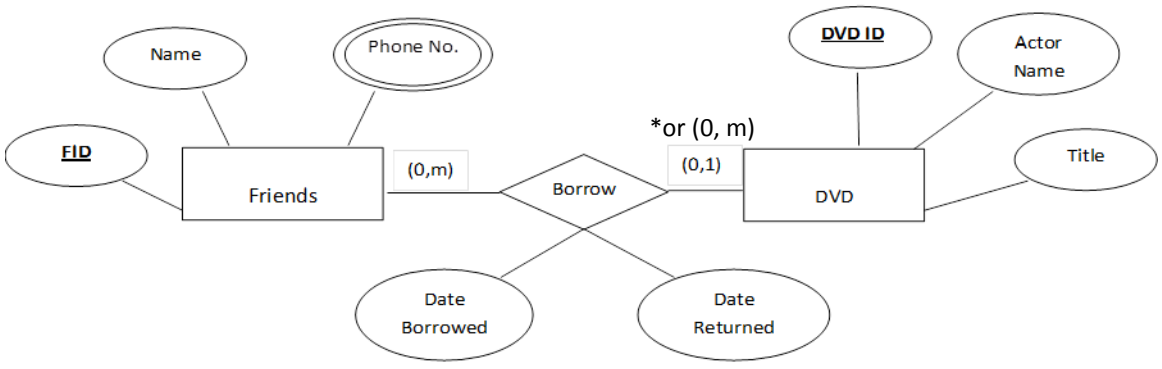
(b). Registration_Number can be a primary key
(c). UID is a candidate key if all students are from the same country
(d). If S is a superkey such that S ∩ UID is NULL then S U UID is also a superkey

Ans: option (a)

Explanation: Candidate Key: All unique value columns in a table are called candidate keys. Its already specified in the question that "A student can have multiple accounts or joint accounts". Hence if two students have a joint account, BankAccount_Number will be the same both the students. Hence BankAccount_Number cannot be a candidate key.

6. [6] Anju 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 numbers which she can call to get the DVD back. With each DVD is the star actor name and title. Whenever a friend borrows a DVD, Anju 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. Anju 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). Prepare an ER model.
Construct an ER model for Anju. Which of the following questions can be answered from your ER diagram? Briefly justify the answers.
(A) Who habitually don't return DVD's quickly?
(B) Who borrowed a DVD multiple times?
(C) Who will be heavy borrowers?
(D) Which DVDs are borrowed by someone at present

Answer:



Assumptions:

- A friend may not borrow or borrow multiple DVDs
- A DVD may not be borrowed or may be borrowed by a friend. In case a friend borrowed it many times, the constraint will be (0,m)
- * In case a DVD is borrowed multiple times

A). Yes, by evaluating difference in days the date borrowed and date returned of the DVD.

B). Yes, by grouping borrower information on friend ID and DVD ID both and checking the count.

C). Yes, by grouping borrower information on friend ID and checking the count.

D). Yes, if Date returned is set NULL, i.e., it is not returned.

7. [5] Consider an ER model in which entity sets E1 and E2 are connected by an m:n relationship R12, E1 and E3 are connected by a 1:n (1 on the side of E1 and n on the side of E3) relationship R13.
E1 has two single-valued attributes a11 and a12 of which a11 is the key attribute. E2 has two single-valued attributes a21 and a22 of which a21 is the key attribute. E3 has two single-valued attributes a31 and a32 of which a31 is the key attribute. The relationships do not have any other attributes.
Derived a relational model from this ER model.

Answer:
Entities E1, E2, and E3 each requires one table:
E1(a11, a12); E2(a21, a22); E3(a31, a32);
Now relation R12 is m:n, Hence requires a table. R12(a11, a21)
R13 is 1:n.
To map 1:n relationships, the primary key on the 'one side' of the relationship is added to the 'many side' as a foreign key. Hence table for E3 is modified to include a11 as a foreign key.

Final schema is
E1(a11, a12); E2(a21, a22); E3(a31, a32, a11); R12(a11, a21)

8. [10] Consider the following database schema of computer products:
Computer(mname,modelnum,category)
Model(modelnum,speed,ram,hd,price)
Maker(mname,address,phone)
where maker indicates the manufacturer of the computer and category takes values such as "desktop", "laptop", "server" etc;

Write the following queries in relational algebra:

(a). Find *all* the makers who make *some* laptop(s)

$T1 \leftarrow \pi_{mname}(\sigma_{category="laptop"}(Computer))$

$Results \leftarrow T1 * Maker$

OR

$T1 \leftarrow \pi_{mname,\ address,\ phone}(\sigma_{category="laptop"}(Computer * Maker))$

(b). Find the phone numbers of *all* the makers who make desktops with speed =3.2

$T1 \leftarrow \sigma_{category="desktop"}(Computer)$

$T2 \leftarrow \sigma_{speed=3.2}(Model)$

$Results \leftarrow \pi_{mname,phone}(T1 * T2 * Maker)$

OR

$T1 \leftarrow \pi_{mname,\ address,\ phone}(\sigma_{category=\text{"desktop" and } speed=3.2}(Computer*Model*Maker))$

(c). Find the makers who don't make any desktop, and do make some laptop(s)

$T1 \leftarrow \sigma_{category=\text{"desktop"}}(Computer)$ ~Makers who make desktop

$T2 \leftarrow \pi_{mname}(Computer) - \pi_{mname}(T1)$ ~Don't make desktop

$T3 \leftarrow \pi_{mname}(\sigma_{category=\text{"laptop"}}(Computer))$

$Result \leftarrow T2 \cap T3$

(d). Find the makers who make all models with speed faster than 3.2

$T1 \leftarrow \pi_{modelnum}(\sigma_{speed>3.2}(Model))$ ~All Models with speed >3.2

$T2 \leftarrow \pi_{mname,modelnum}(Computer)$

$Result \leftarrow T2 \div T1$

(e). Find the manufacturers who manufacture computers with ram more than 32GB and ram less than 8GB.

$T1 \leftarrow \pi_{mname}(\sigma_{ram>32}(Model)* Computer)$

$T2 \leftarrow \pi_{mname}(\sigma_{ram<8}(Model)* Computer)$

$Result \leftarrow T1 \cup T2$

OR

$Result \leftarrow \pi_{mname}((\sigma_{ram<8 \text{ or } ram > 32}(Model)* Computer))$

OR

$Result \leftarrow \pi_{mname}(\sigma_{ram<8 \text{ or } ram > 32}(Model * Computer))$

Note: if it would have been asked that manufacturers who manufacture computer with ram more than 32GB and also ram less than 8GB.
Then $Result \leftarrow T1 \cap T2$

Remember that $\sigma_{ram<8 \text{ and } ram > 32}(Model)$ will not work as either of the condition will be true at any time.