

Indian Institute of Information Technology, Kalyani
Database Management Systems
Class Test II

Maximum Marks 30

Time: 1 hr. 30 mins.

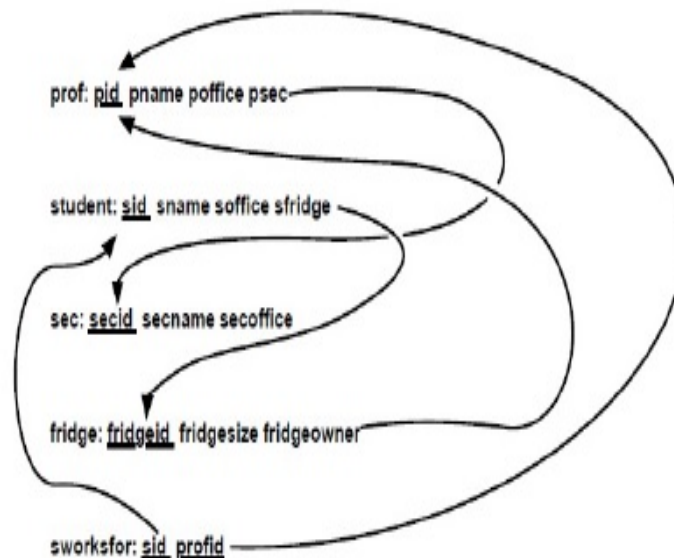
This test will contribute 4% to the total marks.

1. Consider a relational table: Professor(professor_name, professor_id, professor_office_id, student_id, student_name, student_office_id, student_designated_refrigerator_id, refrigerator_owner_id, refrigerator_id, refrigerator_size, secretary_name, secretary_id, secretary_office)

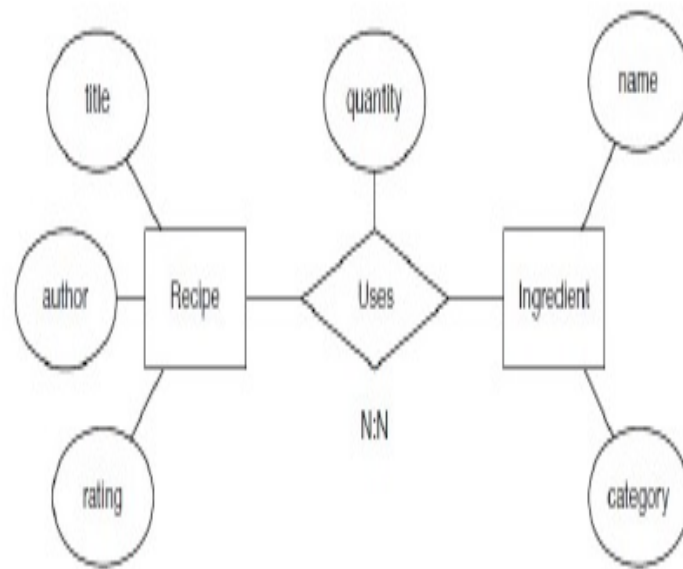
Suppose the data has the following properties:

- A. Professors and secretaries have individual offices, students share offices.
- B. Students can work for multiple professors.
- C. Refrigerators are owned by one professor.
- D. Professors can own multiple refrigerators.
- E. Students can only use one refrigerator.
- F. The refrigerator the student uses must be owned by one of the professors they work for.
- G. Secretaries can work for multiple professors.
- H. Professors only have a single secretary.

- (a) Put this table into 3rd normal form by writing out the decomposed tables; designate keys in your tables by underlining them. Designate foreign keys by drawing an arrow from a foreign key to the primary key it refers to. Note that some of the properties listed above may not be enforced (i.e., guaranteed to be true) by a 3NF decomposition. [10]



- (b) Which of the eight properties (A-H) of the data are enforced (i.e., guaranteed to be true) by the 3NF decomposition and primary and foreign keys you gave above? List only property numbers. [2]
 B,C,D,E,G,H; the schema does not enforce that profs/secretaries have individual offices or that students use the fridge of the professor they work for.
- (c) What could a database administrator do to make sure the properties not explicitly enforced by your schema are enforced by the database? Write a single sentence answer. [1]
 Use triggers or stored procedures to ensure that these constraints are checked when data is inserted or updated.
2. Suppose you have the following schema representing the duties of nurses in the ICU. icuduty(dutyid, nurseid, icustayid, therapyid, patientid, length, report) We denote this schema DNITPLR (representing each table by its first attribute.) Suppose you have the following functional dependencies.
 $D \rightarrow NITPLR$ //duty is key for table
 $I \rightarrow PL$ //each icustay applies to one patient and has a fixed duration
 $N \rightarrow TP$ //the same nurse applies the same therapy to each patient
- (a) Write a BCNF decomposition of this table (you can denote each table simply by the first character of the names of the attributes in it). [5]
 From $I \rightarrow PL$, we decompose DNITPLR into DNITR and IPL. From $N \rightarrow TP$, we have $N \rightarrow T$, we further decompose DNITR into DNIR and NT. We end up with three tables: DNIR, NT, and IPL.
- (b) Is the schema you came up with in the previous problem dependency preserving? Write yes or no. If so, explain why. If not, why not, and what could be done to address the issue? Write single sentence answer. [2]
 It is not dependency preserving in that you need joins to check $N \rightarrow TP$. Add P to NT get NT P. Now they are in 3NF, and hence dependency preserving (but with redundancy!).
3. Suppose you are designing a schema to record information about recipes. Your database needs to record the following information:
 A. For each recipe, its title, author (e.g., grandma), and a rating from 15.
 B. For each recipe, the ingredients it uses, and the quantity of each ingredient (expressed as a string, e.g. 1 cup). Recipes use many ingredients, and ingredients are used by many recipes.
 C. For each ingredient, its name, and a category (e.g., spice, dairy, etc).
- (a) Draw an entity relationship diagram for this database. [4]
- (b) Use your ER diagram to determine a relational schema for this database. Underline the field or fields that comprise the primary key of each table. [4]
 recipe (id, title, author, rating)
 uses (rid ,iid, quantity)
 ingredient (id, name, category)
- (c) Is the schema you developed redundancy free? Does it have any insertion or deletion anomalies? Briefly (in one sentence) state why or why not? [2]
 Yes.
 The above schema is in BCNF. There are no repeated facts or attribute values (besides repeated occurrences of individual rids/iids in the uses table.)



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