Homework Assignment #2
Database Systems – Fall 2023/2024

QUESTION 1

You have been hired to design a database for the scenario below.

A) Create an ER diagram describing all the required entity sets, the relationships between them and constraints on these entities and relationships (keys, referential integrity, etc.).

- Keep your design simple but faithful to the scenario.
- You may add titles to the connecting lines where you think it may be helpful for clarity.
- There may be some requirements the ER diagram is not able to model. Use the ERD tools you have learned to create entity sets, attributes and relationships diagram to best describe the scenario.
- Make sure each entity set has a unique identifier (key).
- You can use any tool you like to create the diagram (power point, visio, graphical software, a scanned page in clear handwriting, ...) but the symbols must be as learned in class.
  Do NOT submit an EER diagram created through MySQL Workbench!

B) Translate the diagram into a relational schema.

Provide the table names, column names, the key(s) of each table and the foreign keys between tables in the following format:

University(name, ranking, address)

Student(ID, name, studies_at)

foreign key:

Student(studies_at) → University(name)

….

When translating "Is a" relationship follow the ER style conversion method.

The scenario:
You will design a schema for a new social network for musical artists, *Muse*.
A user that registers to muse provides his/her details - unique username, first name and last name.

Artists can follow each other, i.e artist u1 follows artist u2.
Artists can upload tracks- which consist of a unique track id, a track name, and 2 additional Attributes- acousticness and loudness. The uploader is the track's main artist.
Artists can feature in other artists' tracks, and in that case they are a guest artist, featuring the track(which has a main artist).

The artists can create an album, and refer existing tracks to that album(so the track “appears in” that album). The album contains a unique album id and an album name.
Finally, the artists can rate tracks. The basic rating contains a unique rating id and a rating(integer between 1 and 5). There’s a more enhanced type of rating which is called an “opinion”- here the rater can also write a short comment, in addition to the rating.

QUESTION 2

Alice got the relation R(A, B, C, D) with the FDs:
A -> B, B -> C, C -> D and D -> B.
She decomposed it into R1(A, B) and R2(B, C), R3(B, D).
A) Is the result of Alice's decomposition lossless? If not, give a counter example. Explain briefly.
B) Is the result of Alice's decomposition dependency preserving? If not, give a counter example. Explain briefly.

QUESTION 3

Given the following relation and set of FDs:

DepartmentCourses(department_id, course_id, department_head, course_name)

department_id -> department_head

course_id -> course_name

department_id, course_id -> department_head, course_name

1. Are there any violations of the BCNF? Explain your answer.
2. What would we benefit from applying a BCNF normalization on this relation? Give 2 advantages with an example for each.

QUESTION 4

You are given a relation R(A, B, C, D, E, F, G, H) with the following functional dependencies.

A, D -> H

B, C -> D

C -> E, B

H -> F, G

A) Find all the nontrivial FDs that follow from the initial set of FDs.

B) Find all the minimal keys for R

C) Decompose R into BCNF using the lossless decomposition algorithm we have learned in class. Show all the decomposition steps and provide (all) the minimal keys of the output relations.