CS5095701 Advanced Database Systems

Homework 1

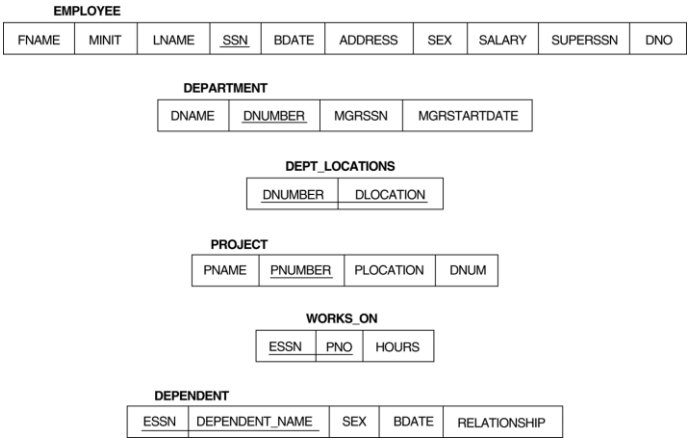
1. (70%) Following are the business descriptions written by domain experts who try to develop a database system for the Tower record company.

- Each song recorded at Tower has a title and one or more authors.
- Each album has one or more songs. But no song can appear on more than one album.
- Each musician that records at tower has an SSN, a name, an address, and a phone number. Musicians that are poorly paid may share the same address. No address has more than one phone.
- Each instrument used in song recorded at Tower has a name (e.g., violin, piano) and a musical key (e.g., B-flat, C-sharp).
- Each album has a title, a copyright date, a format (e.g., CD, vinyl), and an album identification number.
- Each musician may play several instruments, and a given instrument may be play by several musicians.
- Each song is performed by one or more musicians, and a musician may perform a number of songs.
- Each album can have one or more musicians who act as its producers. A musician may produce more than one album.

For the business description above, do the following.

a. (15%) Draw the ER schema diagram.
b. (15%) Convert your ER schema diagram from (a) into a relational schema.
c. (15%) Normalize your relational schema from (b) to Boyce-Codd Normal Form. Justify your answers.
d. (25%) Write the query "*Find the names of the albums with at least one song using the violin and in key C-sharp*" in **relational algebra, tuple relational calculus, domain relational calculus, and SQL**.

2. (30pt) Given the following relational schema:



Consider the following SQL query

```
SELECT FNAME, LNAME, PNUMBER
FROM EMPLOYEE, WORKS_ON, PROJECT
WHERE SSN=ESSN AND PNO=PNUMBER
AND PNAME='ProductX' AND HOURS > 20
```

a. (15%) Draw the query graph.
b. (15%) Draw the query tree that is optimized by the heuristic optimization outlined in class.

Note: You can make any additional assumptions to clarify the descriptions as long as you clearly state them in your answers.