

Professor: Dennis Shasha

Homework 2 - Due: Monday, October 28, 2019 at 4:00 PM

Each question is worth 30 points. You may work with one partner and sign both of your names to your paper or electronic submission. Homeworks should be legible.

1. Suppose we are given five attributes: A B C D E and the following functional dependencies.
 $A \rightarrow C, A \rightarrow B, B \rightarrow C, A \rightarrow E, CE \rightarrow D, DE \rightarrow C, CE \rightarrow A.$

In all your answers, please show your work.

- Find a minimal equivalent (i.e. canonical) set of functional dependencies. (You need not use any special algorithm, though you should be able to follow along based on the notes.)
 - Find a key of A B C D E given these functional dependencies.
 - How many keys are there.
 - Find a lossless, dependency-preserving third normal form decomposition of these attributes into table schema. That is, give the column headers of the tables in the form (X,Y,Z), (W,Z) etc. The tables should result from the minimal canonical set, include a table that has a key and have no table whose attributes are a subset of some other table.
2. A slight variant of the algorithm to produce canonical covers proceeds as follows: Given a set of non-trivial functional dependencies with only one attribute on the right hand side of any FD (never apply the union rule), repeat the following two steps until there is no change:

eliminate all FDs that are transitive consequences of other FDs ,
remove all unnecessary left hand side attributes.

Give an example showing that the second step can introduce new redundant FDs. That is, show how removing an unnecessary left hand side attribute makes some functional dependency redundant (which may or may not be the functional dependency obtained after removing the unnecessary left hand side attribute).

3. You are given the task of designing a relational database for hotel reservations. Each hotel has several room types (e.g. singles, doubles, doubles with views). For that hotel and room type, there are a certain number of rooms available and the room type has a description for that hotel. (Thus the same room type may have a different description for different hotels.) Hotel reservations reserve a certain number of rooms of each type for certain dates. Numberavailable is the number of rooms of that type in the hotel and is constant over time. Numbertaken is the number taken of that type for the hotel for a particular date. (So Numbertaken is always less than or equal to Numberavailable in any row.)

Here is the initial schema (done by someone else):

hotelroomres(hotelid, roomtypeid, description, numberavailable, date, numbertaken)

Find the functional dependencies and decompose this table if necessary into a lossless third normal form design. Identify the keys. Explain the advantages of your decomposition.