Exercise 3

3.1

Consider this (symbolic) relational schema:

`R(a,b,c,d,e)`

The following functional dependencies apply to the relation:

a → b
b, c → d
d, e → a

a) List 3 different minimal keys of the relation. Your solution should be three sets of attributes (the keys).

b) Calculate the following transitive closures. Your solution should be three sets of attributes (the transitive closures), each in alphabetical order.

$\{b, c\}^+$
$\{a, c\}^+$
$\{b, d, e\}^+$

c) Assume all the keys you identified have appropriate unique constraints in R, show a table (the contents of R) that does not respect the functional dependency b, c → d. Use integer values for all the columns.
In other words: Your solution should be a five column table (for columns a, b, c, d, and e) with at least two rows, that does not satisfy the functional dependency, but does have unique values for the three keys you found.

d) Decompose R into BCNF, list all the intermediate steps. Determine all keys for the resulting schema.

3.2

Consider the following relation and functional dependencies:

R(A,B,C,D,E)

A -> B
C -> D
E -> A

Give a real-world example of attributes A,B,C,D,E that would have exactly these dependencies and none else (except of course derived ones). Add any important assumptions you make about the domain.

An attempted example would have the same format as:
Lectures(courseCode, courseTitle, date, room, teacher)

This would reasonably satisfy A -> B (because course code determines the title), and C -> D (because we assume that the course has at most one lecture each date). But it would not satisfy E -> A, because a teacher can have several courses. It might also have the unwanted dependency A C-> E, if we assume that each lecture has one teacher.

3.3

Consider this domain:

Each flight is identified by a flight number and a departure time. Each flight has a set of passenger IDs and a set of airport codes it lands at. Furthermore, each passenger has a set of in-flight movies they have purchased and can use on any flight.

For the relation R(flightNo, departure, airport, passenger, movie), identify all MVDs you can find and normalize R to 4NF.

Extra assignments

If we have spare time, we will solve these exam questions from 2019 (available on the course webpage):

- 2019-06-10, question 2
- 2019-08-29, question 2

Solutions

Will be posted on the course webpage.