UNIVERSITY
OF MANNHEIM
School of Business Informatics
and Mathematics

Data and Web Science Group
Prof. Dr. Heiko Paulheim

Database Technology

Exercise 5: Normal Forms

5.1. Functional Dependencies

a. List all functional dependencies satisfied by the following relation:

A	B	C
A1	B1	C1
A1	B1	C2
A2	B1	C1
A2	B1	C3

b. Check if the following FDs hold for the following table:

   a. A->B

   b. B->C

   c. C->A

   d. AB -> C

   e. AC->B

   f. BC->A

A	B	C
10	B1	C1
10	B2	C2
11	B4	C1
12	B3	C4
13	B1	C1
14	B3	C1

c. Given the database schema R(a, b, c), and a relation r on the schema R,
write an SQL query to test whether the functional dependency b → c holds on relation r .
Also write an SQL assertion that enforces the functional dependency.
Assume that no null values are present.

5.2. Multiple Choise

When is a relation in 1NF?

- o   A relation is always in 1NF
- o   A relation is in 1 NF if every attribute of the relation has atomic content
- o   A relation is not always in 1NF

When is a relation in 2NF (assuming it is already in 1NF)?

- o   If the primary key of a relation consist of exactly one attribute and all other attributes depend on it
- o   If all non-prime attributes depend fully on the primary key
- o   If a relation has a composite key

When is a relation in 3NF (assuming it is already in 1NF)?

- o   If a relation has only one non-prime attribute and it is fully dependend on the primary key
- o   No non-prime attribute dependent on other non-prime attributes and it is in 2NF
- o   If the primary key of a relation consists of exactly one attribute and all other attributes depend on it

In which relations are the normalforms?

- o   Is a relation in 3NF, it is also in 2NF
- o   Is a relation in 2NF, it is also in 3NF
- o   2NF and 3NF do not depend on each other

5.3. Anomalies

StudentID	Name	CourseID	CourseTitle	Organizational Unit	Building
512874	Coen Piper	460	Database Technology	DWS	26
554867	Reilly Harvey	652	Data Security	TCS	30
512874	Coen Piper	652	Data Security	TCS	30
457214	Elina Burn	652	Data Security	TCS	30

- a.   Given the following relation there are three types of anomalies (insert/delete/update). Find an example for each of these anomalies.
- b.   Write the relation down in relational form (underline the primary key)
- c.   Normalise the relation to 1NF
- d.   Write down all functional dependencies
- e.   Normalise the relation to 2NF
- f.   Normalise the relation to 3NF

5.4. Compact Disc

We have a database for CD storage. It contains information about their albums and tracks.

CD_ID	Album	FoundingYear	Titles
66	Michael Jackson - Thriller	1971	{1. Wanna Be Startin' Somethin' 2. Baby Be Mine}
50	AC/DC - Back in Black	1973	{1. Hells Bells 2. *Shoot to Thrill}*
45	Pink Floyd - The Dark Side of the Moon	1965	{1. Speak to Me, 2. On the Run}

a. Normalize the relation to 1NF and write it down in the same way as above
b. Convert it to relational form and underline the primary key
c. Normalise the relation to 2NF
d. Normalise the relation to 3NF