University of Toronto
CSC343

In-class Exercises: Properties of Decompositions

1. **A lossy join decomposition.** Suppose we have a relation with attributes cdf, name, grade. Here is an instance of that relation:

cdf	name	grade
g3tout	Amy	91
g4foobar	David	78
c0zhang	David	85

   (a) Suppose we were to decompose this into two new relations: R1(cdf, name) and R2(name, grade). Project the data onto those two new relations.

R1:

cdf	name

R2:

name	grade

   (b) Now compute $R1 \bowtie R2$ to rebuild the original table.

cdf	name	grade

   (c) What was lost?

Solution: The rebuilt table has 5 rows. New rows are in bold. We have lost the information that the grade of 78 is for g4foobar and the grade of 85 is for c0zhang.

cdf	name	grade
g3tout	Amy	91
g4foobar	David	78
c0zhang	David	85
g4foobar	**David**	**85**
c0zhang	**David**	**78**

2. **A decomposition that fails to preserve dependencies** [Example 3.25 from the text.] Suppose we have a relation with attributes movie, theatre, city and FDs { theatre → city; movie, city → theatre }. The FD theatre → city violates BCNF, and applying the BCNF decomposition algorithm, we get two new relations:

   - R1(theatre, city) with one FD: theatre → city
   - R2(theatre, movie) with no FDs

   (a) Create small instances of R1 and R2 that satisfy their own FDs, but when natural-joined together, violate one of the original FDs.

   Solution: Here is one example answer.

R1:

theatre	city
Kingsway Theatre	Toronto
Varsity Cinema	Toronto

R2:

theatre	movie
Kingsway Theatre	The Matrix
Varsity Cinema	The Matrix

R1 ⋈ R2:

theatre	city	movie
Kingsway Theatre	Toronto	The Matrix
Varsity Cinema	Toronto	The Matrix

   (b) In the original relation, with attributes movie, theatre, city, does the functional dependency theatre → city violate 3NF?

   Solution:
   No, city is part of the key (city, movie).

   (c) In the original relation, with attributes movie, theatre, city, does the functional dependency theatre → city violate BCNF?

   Solution:
   Yes, because theatre is not a key. It does not functionally determine movie.