

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: $R_1(\text{cdf}, \text{name})$ and $R_2(\text{name}, \text{grade})$. Project the data onto those two new relations.

R1:

cdf	name
g3tout	Amy
g4foobar	David
c0zhang	David

R2:

name	grade
Amy	91
David	78
David	85

- (b) Now compute $R_1 \bowtie R_2$ to rebuild the original table.

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

uh oh!

- (c) What was lost?

We didn't lose tuples. Every original tuple is there.
We lost information. We no longer know which David got which mark.

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 \rightarrow city; movie, city \rightarrow theatre }. The FD theatre \rightarrow city violates BCNF, and applying the BCNF decomposition algorithm, we get two new relations:

- R1(theatre, city) with one FD: theatre \rightarrow 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.

R1:

theatre	city
Varsity	Toronto
Royal	Toronto

R2:

theatre	movie
Varsity	Boyhood
Royal	Boyhood

R1 \bowtie R2:

theatre	city	movie
Varsity	Toronto	Boyhood
Royal	Toronto	Boyhood

} Violates
movie, city \rightarrow theatre

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

No - theatre may not be a superkey,
but city is "prime".

I.e., city is part of a key (the key {movie, city})

(c) In the original relation, does the functional dependency theatre \rightarrow city violate BCNF?

Yes - because theatre is not a superkey.

The BCNF algorithm would decompose as shown,
and lose a dependency.