

Homework 5 Solutions

Problem 1:

SupNr \rightarrow Name, Country, Postal Code, Town Street, Street Number gives one set of FDs.

Town, Street, StreetNumber \rightarrow Postal Code

PartNr \rightarrow PartDescription is another set of FDs.

ContactName \rightarrow PhoneNumber is apparently a multi-valued functional dependency.

We might have a FD PartDescription \rightarrow PartNumber, but it is not likely. Similarly, the phone number will probably not determine the ContactName as people working at the same company might share the same telephone.

Problem 2:

We create a tableau, with one row for each table in the decomposition.

A	B	C	D	E
a	b	c	d ₁	e ₁
a ₂	b	c	d	e ₂
a ₃	b	c ₃	d	e

We can only apply $BC \rightarrow E$, which gives us

A	B	C	D	E
a	b	c	d ₁	e ₁
a ₂	b	c	d	e ₁
a ₃	b	c ₃	d	e

At this point, we can apply $BCE \rightarrow A$, which gives us

A	B	C	D	E
a	b	c	d ₁	e ₁
a	b	c	d	e ₁
a ₃	b	c ₃	d	e

Now, we can no longer apply any FD. To form a counterexample, we use the last tableau. By construction, it satisfies all the FDs. We project it on the three tables.

A	B	C
a	b	c
a ₃	b	c ₃

B	C	D
b	c	d ₁
b	c	d
b	c ₃	d

B	D	E
b	d ₁	e ₁
b	d	e ₁
b	d	e

Then $R(A, B, C) \bowtie R(B, C, D)$ is

A	B	C	D
a	b	c	d ₁
a	b	c	d
a ₃	b	c ₃	d

and $(R(A, B, C) \bowtie R(B, C, D)) \bowtie R(B, D, E)$ is

A	B	C	D	E
a	b	c	d ₁	e ₁
a	b	c	d	e ₁
a	b	c	d	e
a ₃	b	c ₃	d	e ₁
a ₃	b	c ₃	d	e

which has more rows than the table with which we started.

Problem 3:

Since the decomposition is the same, we start with the same tableau.

A	B	C	D	E
a	b	c	d ₁	e ₁
a ₂	b	c	d	e ₂
a ₃	b	c ₃	d	e

We use $B, C \rightarrow A$ to obtain

A	B	C	D	E
a	b	c	d ₁	e ₁
a	b	c	d	e ₂
a ₃	b	c ₃	d	e

We now use $A, B, C \rightarrow E$:

A	B	C	D	E
a	b	c	d ₁	e ₁
a	b	c	d	e ₁
a ₃	b	c ₃	d	e

and $B, D \rightarrow E$

A	B	C	D	E
a	b	c	d ₁	e ₁
a	b	c	d	e
a ₃	b	c ₃	d	e

Therefore, the decomposition is lossless.

Problem 4:

1. In an employee table, employee_no determines first_name, but first_name does not determine employee_no.
2. Since $A \rightarrow C$ implies $A, B \rightarrow C$, we can just come up with a table with the first FD and one with $B \nrightarrow C$.

A	B	C
1	3	1
2	3	4
3	4	9
4	4	16