Solutions for the Module 11 Exercise Problems

The exercise problems in Module 11 provide practice with falsify functional dependencies in sample rows and performing schema conversion and normalization together.

1. For the big university database table, list FDs with the column *StdCity* as the determinant that are not true due to the sample data. For each FD, you should identify one falsification example or indicate that no falsification example exists in the sample rows. Remember that it takes two rows to falsify an FD in which the LHS is the same in both rows but the RHS is different.

Table 1: Sample Data for the Big University Database Table

StdNo	**StdCity**	**StdClass**	**OfferNo**	**OffTerm**	**OffYear**	**EnrGrade**	**CourseNo**	**CrsDesc**
S1	SEATTLE	JUN	O1	FALL	2017	3.5	C1	DB
S1	SEATTLE	JUN	O2	FALL	2017	3.3	C2	VB
S2	BOTHELL	JUN	O3	SPRING	2018	3.1	C3	OO
S2	BOTHELL	JUN	O2	FALL	2017	3.4	C2	VB

Answer
stdcity FDs and sample rows that falsify the FDs. The rows refer to the sample data above.

FD	Falsifications
StdCity → *OfferNo*	(1,2), (3,4)
StdCity → *OffTerm*	(3,4)
StdCity → *EnrGrade*	(1,2), (3,4)
StdCity → *CourseNo*	(1,2), (3,4)
StdCity → *CrsDesc*	(1,2), (3,4)
StdCity → *OffYear*	(3,4)
StdCity → *StdNo*	None
StdCity → *StdClass*	None

2. You should add one or more sample rows to Table 1 for the FDs in problem 1 with no falsification example. For each non falsified FD with *StdCity* as the determinant, you should add

one or more sample rows and then identify a falsification example involving the new row(s) and rows from Table 1.

Answer

FDs with *stdcity* as the determinant not falsified by Table 1 are listed below along with a reference to new rows (after row 4) that falsify the FDs.

stdcity → *stdno* is falsified by two pairs of rows: <1,5> and <2,5>
stdcity → *stdclass* is falsified by two pairs of rows: <1,5> and <2,5>

StdNo	**StdCity**	**StdClass**	**OfferNo**	**OffTerm**	**OffYear**	**EnrGrade**	**CourseNo**	**CrsDesc**
S1	SEATTLE	JUN	O1	FALL	2013	3.5	C1	DB
S1	SEATTLE	JUN	O2	FALL	2013	3.3	C2	VB
S2	BOTHELL	JUN	O3	SPRING	2014	3.1	C3	OO
S2	BOTHELL	JUN	O2	FALL	2013	3.4	C2	VB
S3	SEATTLE	SR	O1	FALL	2014	3.3	C1	DB

3. Convert the ERD in Figure 1 into tables and perform further normalization as needed. Your conversion result should show the list of tables with primary keys, foreign keys, and not null constraints. After converting the ERD to tables, specify FDs for each table. Since the primary key of each table determines the other columns, you should only identify FDs in which the LHS is not the primary key. If a table is not in BCNF, explain why and split it into two or more tables that are in BCNF.

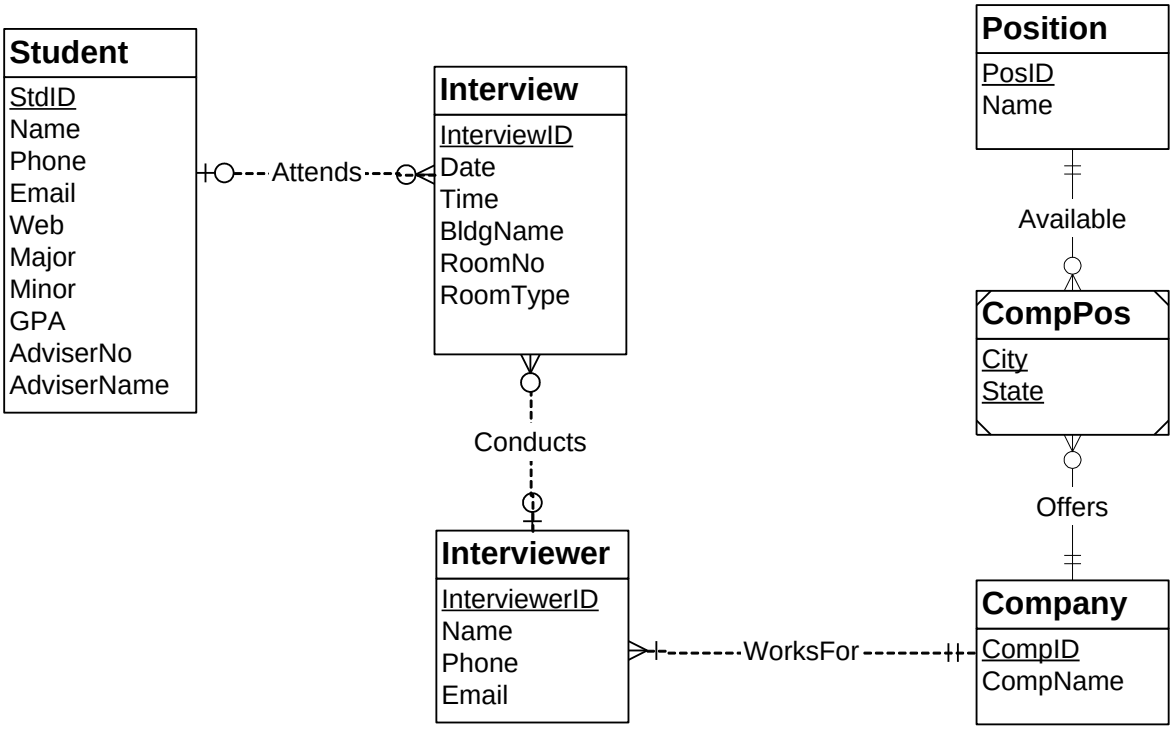

Figure 1: ERD for Problem 3

Result after conversion

Student(StdId, Name, Email, Phone, Web, Major, Minor, GPA, AdviserNo, AdviserName)

Interview(Interviewid, BldgName, RoomNo, RoomType, Date, Time, *StdId*, *InterviewerId*)
FOREIGN KEY(InterviewerId) REFERENCES Interviewer
FOREIGN KEY(StdId) REFERENCES Student

Interviewer(InterviewerId, Name, Phone, Email, *CompId*)
FOREIGN KEY(CompId) REFERENCES Company
CompId NOT NULL

Company(CompId, CompName)

Position(PosId, Name)

CompPos(CompId, PosId, City, State)
FOREIGN KEY(CompId) REFERENCES Company
FOREIGN KEY(PosId) REFERENCES Position

Further normalization

- The student table is not in BCNF because AdviserNo → AdviserName. If this FD is significant, split student into 2 tables with AdviserNo and AdviserName in a new table. AdviserNo is the primary key of the new table.

- The Interview table is not in BCNF because BldgName, RoomNo → RoomType. If this FD is significant split interview into 2 tables with BldgName, RoomNo, and RoomType in a new table. The combination of BldgName and RoomNo is the primary key of the new table.
- Another possible interpretation of the RoomNo attribute is that it contains both a building abbreviation and a room number. For example, PL212 means room 212 in the Plaza building. If RoomNo contains both a room number and a building abbreviation, then RoomNo→ BldgName, RoomType. If this FD is significant split the interview table into 2 tables with BldgName, RoomNo, and RoomType in a new table. The primary key of the new table is RoomNo.

4. Apply the simple BCNF procedure to the following list of FDs. Show the result of each step. In the final list of tables, you should show the primary keys, foreign keys, and unique constraints.

   You do not need to write CREATE TABLE statements.

   AuthNo → AuthName
   AuthEmail → AuthNo
   PaperNo → Primary-AuthNo
   AuthNo → AuthAddress
   AuthNo → AuthEmail
   PaperNo → PapTitle
   PaperNo → PapAbstract
   PaperNo → PapStatus
   RevNo → RevName
   RevNo → RevEmail
   RevEmail → RevNo
   RevNo, PaperNo → Auth-Comm
   RevNo, PaperNo → Prog-Comm
   RevNo, PaperNo → RevDate
   RevNo, PaperNo → Rating
   RevNo → RevAddress

   Step 1: Arrange the remaining FDs into groups by determinant

   AuthNo → AuthName, AuthEmail, AuthAddress
   AuthEmail → AuthNo
   PaperNo → Primary-AuthNo, Title, Abstract, Status
   RevNo → RevName, RevEmail, RevAddress
   RevEmail → RevNo
   RevNo, PaperNo → Auth-Comm, Prog-Comm, Date, Rating1, Rating2, Rating3,

   Step 2: For each FD group, make a table with the determinant as the primary key. In the table list, the primary keys are underlined.

   Author(<u>AuthNo</u>, AuthName, AuthEmail, AuthAddress)

FOREIGN KEY (AuthEmail) REFERENCES Author
AuthEmail(AuthEmail, AuthNo)
FOREIGN KEY (AuthNo) REFERENCES Author

Paper(PaperNo, Primary-AuthNo, Title, Abstract, Status)
FOREIGN KEY (Primary-AuthNo) REFERENCES Author
Reviewer(RevNo, RevName, RevEmail, RevAddress)
FOREIGN KEY (RevEmail) REFERENCES ReviewerEmail
ReviewerEmail(RevEmail, RevNo)
FOREIGN KEY (RevNo) REFERENCES Reviewer
Review(PaperNo, RevNo, Auth-Comm, Prog-Comm, Date, Rating1, Rating2, Rating3, Rating4, Rating5)
FOREIGN KEY (PaperNo) REFERENCES Paper
FOREIGN KEY (RevNo) REFERENCES Reviewer

Step 3: Merge tables with the same columns. The Author and AuthEmail tables are merged. The Reviewer and ReviewerEmail tables are merged. UNIQUE constraints are added for AuthEmail and RevEmail.

Author(AuthNo, AuthName, AuthEmail, AuthAddress)
UNIQUE (AuthEmail)
Paper(PaperNo, Primary-AuthNo, Title, Abstract, Status)
FOREIGN KEY (Primary-AuthNo) REFERENCES Author
Reviewer(RevNo, RevName, RevEmail, RevAddress)
UNIQUE (RevEmail)
Review(PaperNo, RevNo, Auth-Comm, Prog-Comm, Date, Rating1, Rating2, Rating3, Rating4, Rating5)
FOREIGN KEY (PaperNo) REFERENCES Paper
FOREIGN KEY (RevNo) REFERENCES Reviewer