

NORMALIZATION

- 14.14. Examine the Patient Medication Form for the Wellmeadows Hospital case study shown in Figure 14.18.

Wellmeadows Hospital Patient Medication Form							
Patient Number: <u>P10034</u>							
Full Name: <u>Robert MacDonald</u>				Ward Number: <u>Ward 11</u>			
Bed Number: <u>84</u>				Ward Name: <u>Orthopaedic</u>			
Drug Number	Name	Description	Dosage	Method of Admin	Units per Day	Start Date	Finish Date
10223	Morphine	Pain Killer	10mg/ml	Oral	50	24/03/13	24/04/14
10334	Tetracycline	Antibiotic	0.5mg/ml	IV	10	24/03/13	17/04/13
10223	Morphine	Pain Killer	10mg/ml	Oral	10	25/04/14	02/05/15

Figure 14.18 The Wellmeadows Hospital Patient Medication Form.

- (a) Identify the functional dependencies represented by the data shown in the form in Figure 14.18.

Solution:

patientNo → *fullName*

wardNo → *wardName*

wardName → *wardNo*

drugNo → *name, description, dosage, methodOfAdmin*

patientNo, drugNo, startDate → *unitsPerDay, finishDate*

The functional dependencies for bedNo are unclear. If bedNo was a unique number for the entire hospital, then we could say that bedNo → wardNo. However, from further examination of the requirements specification, we can observe that bedNo is to do with the allocation of patients on the waiting list to beds.

- (b) Describe and illustrate the process of normalizing the data shown in Figure 13.19 to First (1NF), Second (2NF), and Third (3NF).

Solution:

First Normal Form

(patientNo, drugNo, startDate, fullName, wardNo, wardName, bedNo, name, description, dosage, methodOfAdmin, unitsPerDay, finishDate)

Second Normal Form

(patientNo, drugNo, startDate, wardNo, wardName, bedNo, unitsPerDay, finishDate)

(drugNo, name, description, dosage, methodOfAdmin)

(patientNo, fullName)

Third Normal Form

(patientNo, drugNo, startDate, wardNo, bedNo, unitsPerDay, finish Date)

(drugNo, name, description, dosage, methodOfAdmin)

(patientNo, fullName)

(wardNo, wardName)

- (c) Identify the primary, alternate, and foreign keys in your 3NF relations.

Solution:

(patientNo (FK), drugNo(FK), startDate, wardNo(FK), bedNo, unitsPerDay, finishDate)

(drugNo, name, description, dosage, methodOfAdmin)

(patientNo, fullName)

(wardNo, wardName (AK))

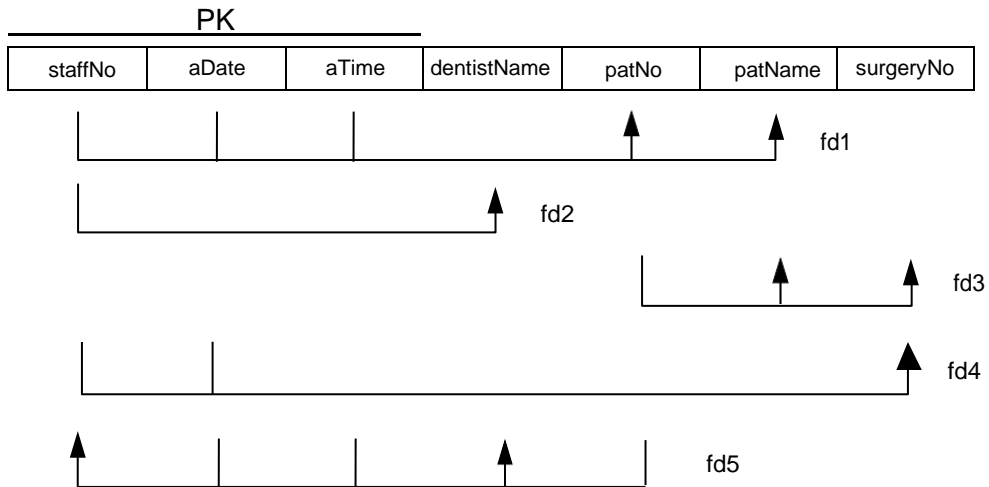
14.15 The table shown in Figure 14.19 lists sample dentist/patient appointment data. A patient is given an appointment at a specific time and date with a dentist located at a particular surgery. On each day of patient appointments, a dentist is allocated to a specific surgery for that day.

- The table shown in Figure 14.19 is susceptible to update anomalies. Provide examples of insertion, deletion, and update anomalies.
- Identify the functional dependencies represented by the attributes shown in the table of Figure 14.19. State any assumptions you make about the data and the attributes shown in this table.
- Describe and illustrate the process of normalizing the table shown in Figure 14.19 to 3NF relations. Identify the primary, alternate, and foreign keys in your 3NF relations.

staffNo	dentistName	patNo	patName	appointment date	time	surgeryNo
S1011	Tony Smith	P100	Gillian White	12-Sep-13	10.00	S15
S1011	Tony Smith	P105	Jill Bell	12-Sep-13	12.00	S15
S1024	Helen Pearson	P108	Ian MacKay	12-Sep-13	10.00	S10
S1024	Helen Pearson	P108	Ian MacKay	14-Sep-13	14.00	S10
S1032	Robin Plevin	P105	Jill Bell	14-Sep-13	16.30	S15
S1032	Robin Plevin	P110	John Walker	15-Sep-13	18.00	S13

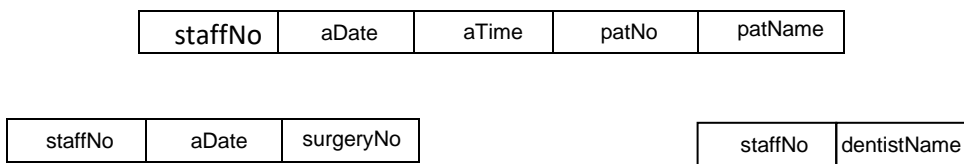
Figure 14.19 Table displaying sample dentist/patient appointment data.

1NF



fd2 and fd4 violates 2NF

2NF



Fd3' violates 3NF

3NF



14.17 A company called *FastCabs* provides a taxi service to clients. The table shown in Figure 14.21 displays some details of client bookings for taxis. Assume that a taxi driver is assigned to a single taxi, but a taxi can be assigned to one or more drivers.

- Identify the functional dependencies that exist between the columns of the table in Figure 14.21 and identify the primary key and any alternate key(s) (if present) for the table.
- Describe why the table in Figure 14.21 is not in 3NF.
- The table shown in Figure 14.21 is susceptible to update anomalies. Provide examples of how insertion, deletion, and modification anomalies could occur on this table.

JobID	JobDate Time	driverID	driver Name	taxiID	clientID	clientName	jobPickUpAddress
1	25/07/14 10.00	D1	Joe Bull	T1	C1	Anne Woo	1 Storrie Rd, Paisley
2	29/07/14 10.00	D1	Joe Bull	T1	C1	Anne Woo	1 Storrie Rd, Paisley
3	30/07/14 11.00	D2	Tom Win	T2	C1	Anne Woo	3 High Street, Paisley
4	2/08/14 13.00	D3	Jim Jones	T3	C2	Mark Tin	1A Lady Lane, Paisley
5	2/08/14 13.00	D4	Steven Win	T1	C3	John Seal	22 Red Road, Paisley
6	25/08/14 10.00	D2	Tom Win	T2	C4	Karen Bow	17 High Street, Paisley

Figure 14.21 Table displaying sample data for *FastCabs*.

15.6 On completion of Exercise 14.14 examine the 3NF relations created to represent the attributes shown in the Wellmeadows Hospital form shown in Figure 14.18. Determine whether these relations are also in BCNF. If not, transform the relations that do not conform into BCNF.

The only relations that may violate BCNF are those that have more than one candidate key. Therefore we need only re-examine the Ward relation, which has a wardNo as a PK and wardName as an alternate key. This relation contains the following functional dependencies:

$\text{wardNo} \rightarrow \text{wardName} \text{ (fd1)}$

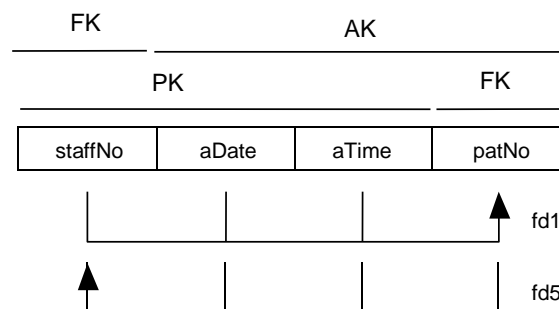
$\text{wardName} \rightarrow \text{wardNo} \text{ (fd2)}$

The presence of fd2 does not break BCNF because wardName is a candidate key for this relation. Hence the Ward relation is in BCNF.

As the other relations shown in the answer for Exercise 14.14 have only one candidate key, they must also be in BCNF.

- 15.7 On completion of Exercise 14.15 examine the 3NF relations created to represent the attributes shown in the relation that displays dentist/patient appointment data in Figure 14.19. Determine whether these relations are also in BCNF. If not, transform the relations that do not conform into BCNF.

The only relations that may violate BCNF are those that have more than one candidate key. Therefore we need only re-examine the Appointment relation, which has (staffNo, aDate, aTime) as a PK and (patNo, aDate, aTime) as an alternate key. This relation contains the following functional dependencies:



The presence of fd5 does not break BCNF because (patNo, aDate, aTime) is a candidate key for this relation. Hence the Appointment relation is in BCNF.

As the other relations shown in the answer for Exercise 14.15 have only one candidate key, they must also be in BCNF.