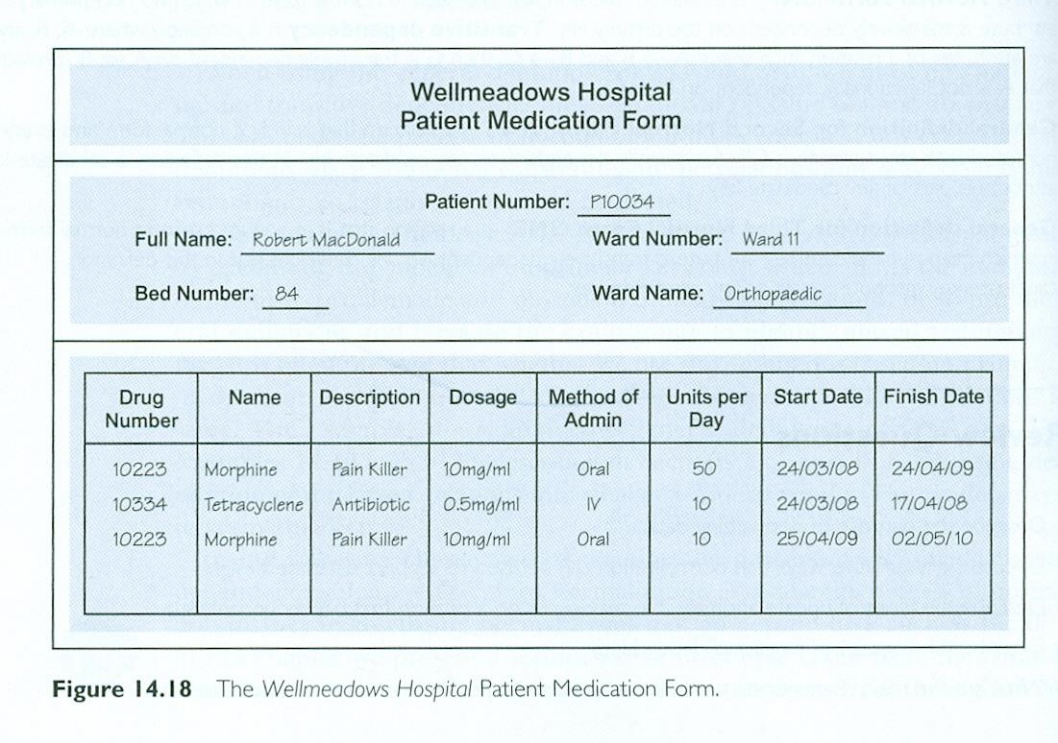
Database Design, CSCI 340, Spring 2016
Normalization to BCNF exercises, March 23

1. Decompose the following relation into BCNF if it is not already in BCNF.



Wellmeadows Hospital
Patient Medication Form

Patient Number: P10034
Full Name: Robert MacDonald
Ward Number: Ward 11
Bed Number: 84
Ward Name: Orthopaedic

Drug Number	Name	Description	Dosage	Method of Admin	Units per Day	Start Date	Finish Date
10223	Morphine	Pain Killer	10mg/ml	Oral	50	24/03/08	24/04/09
10334	Tetracyclene	Antibiotic	0.5mg/ml	IV	10	24/03/08	17/04/08
10223	Morphine	Pain Killer	10mg/ml	Oral	10	25/04/09	02/05/10

Figure 14.18 The *Wellmeadows Hospital* Patient Medication Form.

Table including all attributes:

PatientMedication(patNo, fullName, bedNo, wardNo, wardName, drugNo, drugName,drugDescription, drugDosage, drugMethod, drugUnit, startDate, finishDate)

Apparent FDs (Get more details of Wellmeadows in appendix, B-5):

1. patNo → fullName
2. wardNo → wardName
3. wardName → wardNo
4. drugNo → drugName, drugDescription (not clear if drugDosage and drugMethod are functionally determined from the drugNo)
5. patNo, startDate → wardNo, wardName, bedNo
6. patNo, startDate, drugNo → all
7. patNo, finishDate, drugNo → all

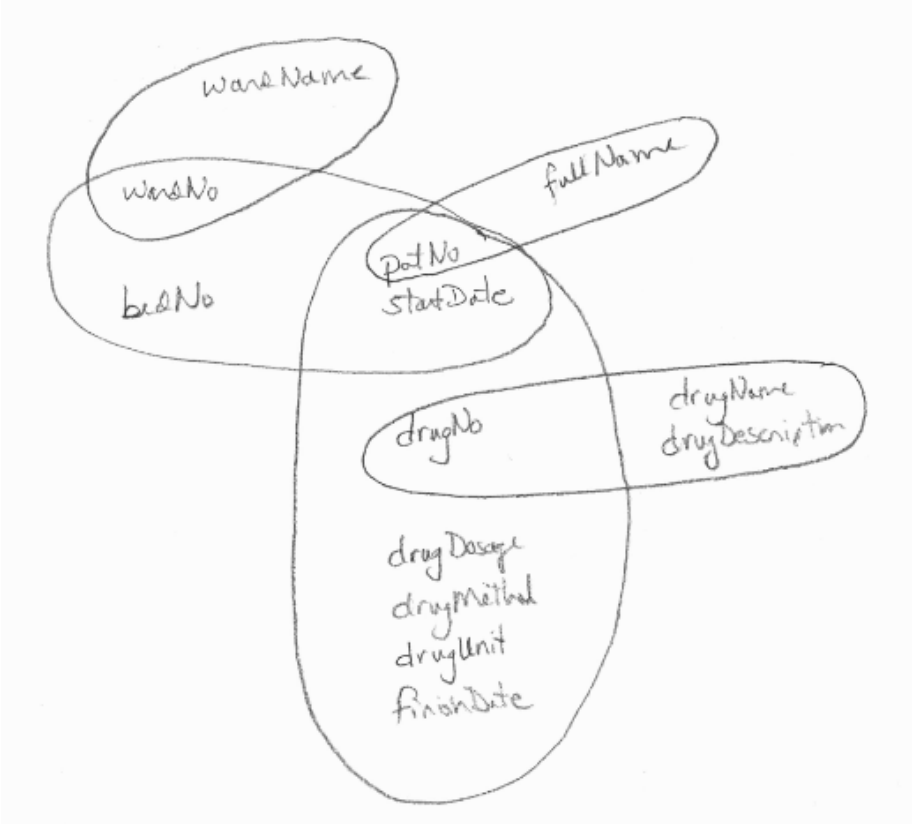
Candidate keys:

1. patNo, startDate, drugNo
2. patNo, finishDate, drugNo

BCNF violations:

1. patNo → fullName
2. wardNo → wardName
3. wardName → wardNo
4. drugNo → drugName, drugDescription
5. patNo, startDate → wardNo, wardName, bedNo

Decomposition:



Which gives the relations:

Patient (patNo, patName)
Ward(wardNo, wardName)
Drug(drugNo, drugName, drugDescription)
Stay(patNo, startDate, wardNo, bedNo)
MedicationAdmin(patNo, drugNo, drugDosage, drugAdmin, drugUni, startDate, finishDate)

Are each of these in BCNF?

Patient (patNo, patName)

patNo → fullName

Is in BCNF.

Ward(wardNo, wardName)

wardNo → wardName

wardName → wardNo

Is in BCNF.

Drug(drugNo, drugName, drugDescription)

drugNo → drugName, drugDescription

Is in BCNF.

Stay(patNo, startDate, wardNo, bedNo)

patNo, startDate → wardNo, bedNo

Is in BCNF.

MedicationAdmin(patNo, drugNo, drugDosage, drugAdmin, drugUni, startDate, finishDate)

patNo, startDate, drugNo→drugDosage, drugAdmin, drugUnit, finishDate

Is in BCNF.

Final answer:

Patient (patNo, patName)

Ward(wardNo, wardName)

Drug(drugNo, drugName, drugDescription)

Stay(patNo, startDate, wardNo, bedNo)

MedicationAdmin(patNo, drugNo, drugDosage, drugAdmin, drugUni, startDate, finishDate)

2. Consider Exercise 14.15:

staffNo	dentistName	patNo	patName	appointment date	time	surgeryNo
S1011	Tony Smith	P100	Gillian White	12-Sep-08	10.00	S15
S1011	Tony Smith	P105	Jill Bell	12-Sep-08	12.00	S15
S1024	Helen Pearson	P108	Ian MacKay	12-Sep-08	10.00	S10
S1024	Helen Pearson	P108	Ian MacKay	14-Sep-08	14.00	S10
S1032	Robin Plevin	P105	Jill Bell	14-Sep-08	16.30	S15
S1032	Robin Plevin	P110	John Walker	15-Sep-08	18.00	S13

Figure 14.19 Table displaying sample dentist/patient appointment data.

a. Give examples of insert, update and delete anomalies for the relation above..

Insert – A new staff member has joined the office but doesn't have any appointments, so can't be added to the relation without adding nulls.

Update – Staff member Robin's name is not 'Plevin' but "Kevin". Multiple changes need to be made and the db may become inconsistent

Delete – John Walker cancels his appointment, but when the appointment record is deleted, all information about John Walker is lost.

b. Find all the FDs in the following (state any assumptions that you use)

staffNo → dentistName
dentistName → staffNo
patNo → patName
patName → patNo
staffNo, appointDate, AppointTime → patNo, surgery, dentistName, patName
patNo, appointDate, AppointTime → staffNo, surgery, dentistName, patName
surgery, appointDate, AppointTime → staffNo, patNo, dentistName, patName

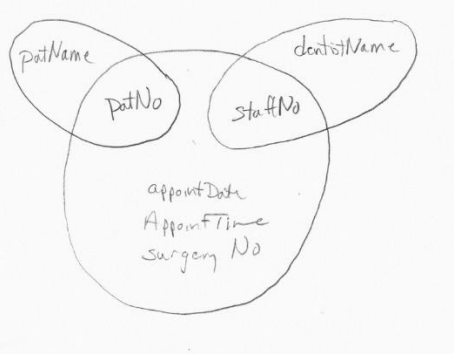
c. Normalize the table to BCNF.

Table including all attributes:
DentistPatientAppointment(staffNo, dentistName, patNo, patName, apptDateTime, surgeryNo)

Candidate keys appear to be:
staffNo, appointDate, AppointTime
patNo, appointDate, AppointTime
surgery, appointDate, AppointTime

Offending FDs:
staffNo → dentistName
dentistName → staffNo
patNo → patName
patName → patNo

Normalize:



Result:
Staff(staffNo, dentistName)
Patient (patNo, pName)
Appoint(staffNo, appointDate, AppointTime, patNo, surgeryNo)

Are each of these relations in BCNF?

Staff(staffNo, dentistName)
staffNo → dentistName
dentistName → staffNo
Yes, in BCNF.

Patient (patNo, pName)
patNo → patName
patName → patNo
Yes, in BCNF.

Appoint(staffNo, appointDate, AppointTime, patNo, surgeryNo)

staffNo, appointDate, AppointTime → patNo, surgery

patNo, appointDate, AppointTime → staffNo, surgery

surgery, appointDate, AppointTime → staffNo, patNo

Yes, in BCNF.

Answer:

Staff(staffNo, dentistName)

Patient (patNo, pName)

Appoint(staffNo, appointDate, AppointTime, pathNo, surgery)

3. The following relation has the FDs listed below.

Choir

sId	abbrev	pID	fName	lName	title_p	composer	years	dateTime	title_s
1	Leben	1	Billie	Meyer	Austria My Home	Schubert	1797-1828	2013-12-22 19:00:00	Lebenslust
3	Kyrie	1	Rich	Myer	Austria My Home	Beethoven	1770-1827	2013-12-22 19:00:00	Kyrie
3	Maria	1	Rich	Myer	Austria My Home	Schubert	1797-1828	2013-12-22 19:00:00	Ave Maria
3	Kyrie	2	Rich	Myer	Spring in the Air	Beethoven	1770-1827	2013-05-12 19:00:00	Kyrie
4	Leben	2	Jenn	Swartz	Spring in the Air	Schubert	1797-1828	2013-05-12 19:00:00	Lebenslust
5	Maria	2	Rich	Vandick	Spring in the Air	Schubert	1797-1828	2013-05-12 19:00:00	Ave Maria
2	Maria	3	Butch	Lee	Snowy Christmas	Schubert	1797-1828	2014-12-24 19:00:00	Ave Maria
4	Leben	3	Jenn	Swartz	Snowy Christmas	Schubert	1797-1828	2014-12-24 19:00:00	Lebenslust

8 rows in set (0.00 sec)

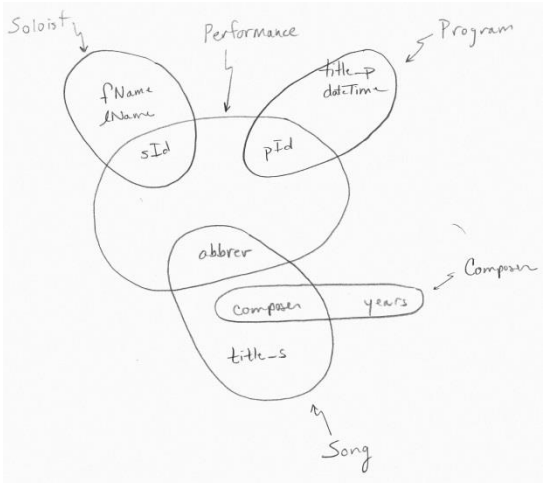
pID → title_p, dateTime
sId → fName, lName
abbrev → song, composer, years, title_s
composer → years
pId, abbrev → sId and everything else

Key: pId, abbrev

Normalize this relation to BCNF, if it is not already in BCNF.

Since the key is pId, abbrev the relation is not in BCNF because the first 4 FDs are offending.

Normalize:



Result:
Program(pId, title_p, dateTime)
Soloist(sId, fName, lName)
Song(abbrev, composer, title_s)
Composer(composer, years)
Performance(pId, abbrev, sId)

Are each of these relations in BCNF?

Program(pId, title_p, dateTime)
pID → title_p, dateTime
Yes, in BCNF.

Soloist(sId, fName, lName)
sId → fName, lName
Yes, in BCNF.

Song(abbrev, composer, title_s)
abbrev → song, composer, title_s
Yes, in BCNF.

Composer(composer, years)
composer → years
Yes, in BCNF.

Performance (pId, abbrev, sId)
pId, abbrev → sId
Yes, in BCNF.

Answer:
Program(pId, title_p, dateTime)
Soloist(sId, fName, lName)
Song(abbrev, composer, title_s)
Composer(composer, years)
Performance (pId, abbrev, sId)