

**PART I:** An agency called supplies part-time/temporary staff to hotels within Scotland. The table below displays sample data, which lists the time spent by agency staff working at various hotels. The National Insurance Number (NIN) is unique for every member of staff.

NIN	contractNo	hours	eName	hNo	hLoc
1135	C1024	16	Smith J	H25	East Killbride
1057	C1024	24	Hocine D	H25	East Killbride
1068	C1025	28	White T	H4	Glasgow
1135	C1025	15	Smith J	H4	Glasgow

1NF: (NIN, contractNo), hours, eName, hNo, hLoc

a) List the business rules that you will use to put this data into 3NF. **(10 points)**

1. Findings and Observations:

- . The non-prime attribute hLoc is dependent on candidate key hNo.
- i. The non-prime attributes eName, hours, and contractNo are dependent on candidate key NIN.
- ii. This shows the partial dependencies
- iii. Also, there exist transitive dependency  $NIN \rightarrow hNO \rightarrow hLoc$

2. Conversion to 2NF

i. Partial dependencies need to be removed by splitting the table as below:

2NF				
NIN (PK)	contractNo	hours	eName	hNo (FK)
1135	C1024	16	Smith J	H25
1057	C1024	24	Hocine D	H25
1068	C1025	28	White T	H4
1135	C1025	15	Smith J	H4

  

hNo (PK)	hLoc
H25	East Killbride
H4	East Killbride
H4	Glasgow
H4	Glasgow

c. Conversion to 3NF

- i. Transitive dependencies are to be removed by splitting tables as below:

3NF				
NIN (PK)	contractNo	hours	eName	hNo (FK)
1135	C1024	16	Smith J	H25
1057	C1024	24	Hocine D	H25
1068	C1025	28	White T	H4
1135	C1025	15	Smith J	H4

  

hNo (PK)	hLoc
H25	East Killbride
H25	East Killbride
H4	Glasgow
H4	Glasgow

  

NIN			
NIN (PK)	hNo (PK)	hLoc	
1135	H25	East Killbride	
1057	H25	East Killbride	
1068	H4	Glasgow	
1135	H4	Glasgow	

- b) List the partial dependencies and the transitive dependencies using the notations shown above. (5 points)

Partial dependency is shown with this notation:

hNo -> hLoc  
NIN -> eName, hours, contractNo,

Transitive dependency is shown with this notation:

NIN -> hNo -> hLoc

- c) Remove the partial dependencies and show the 2NF relations. (5 points)

2NF				
NIN (PK)	contractNo	hours	eName	hNo (FK)
1135	C1024	16	Smith J	H25
1057	C1024	24	Hocine D	H25
1068	C1025	28	White T	H4
1135	C1025	15	Smith J	H4

  

hNo (PK)	hLoc
H25	East Killbride
H25	East Killbride
H4	Glasgow
H4	Glasgow

- d) Remove the transitive dependencies and show the 3NF relations. Make sure to list the PK's and FK's. (10 points)

3NF				
NIN (PK)	contractNo	hours	eName	hNo (FK)
1135	C1024	16	Smith J	H25
1057	C1024	24	Hocine D	H25
1068	C1025	28	White T	H4
1135	C1025	15	Smith J	H4

  

Hotel			
hNo (PK)	hLoc	NIN (PK)	hNo (FK)
H25	East Killbride	1135	H25
H25	East Killbride	1057	H25
H4	Glasgow	1068	H4
H4	Glasgow	1135	H4

Part II: Appendix B of your textbook describes three case studies for database design. The third case study describes a small hospital in Edinburgh that specializes in the provision of health care for the elderly people.

The Wellmeadows Hospital has 17 wards with a total of 240 beds available for the short- and long-term patients, and an outpatient clinic. Each ward is uniquely identified by a number (for example, ward 11) and also a ward name (for example, Orthopaedic), location (for example, E Block) and total number of beds.

When a patient is first referred to the hospital, he or she is allocated a unique patient number. When a patient is prescribed medication, the details are recorded. This includes the patient's name and number, drug number and name, units per day, method of administration (for example, oral or intravenous (IV)), start and finish date. An example of a Wellmeadows Hospital report used to record the details of medication given to a patient called Robert MacDonald is shown below:

Wellmeadows Hospital Patient Medication Form							
Full Name: Robert MacDonald		Patient Number: P10234		Ward Number: Ward 11			
Bed Number: 04				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	24/03/15	24/04/14
10234	Tetracycline	Antibiotic	0.5mg/ml	IV	10	24/03/15	17/04/15
10223	Morphine	Pain Killer	10mg/ml	Oral	10	25/04/14	02/05/15

1NF relation with a combined primary key: (patientNo, drugNo, startDate) fullName, wardNo, bedNo, drugName, description, dosage, methodOfAdmin, unitsPerDay, finishDate

- a) List the business rules that you will use to put this data into 3NF. (10 points)
- Findings and Observations:
    - The non-prime attributes fullName, finishDate are dependent on candidate key patientNo.
    - The non-prime attribute wardName is dependent on candidate key wardNo.
    - The non-prime attributes drugName, description, and methodOfAdmin are dependent on drugNo.
    - The non-prime attributes dosage, finishDate, drugNo, and patientNo are dependent on the startDate.
    - The above shows the partial dependencies.
    - The following shows the transitive dependencies
      - patientNo -> wardNo -> bedNo

- patientNo -> drugNo -> drugName
- drugNo -> dosage -> unitsPerDay

b. Conversion to 2NF

1NF					
Patient	FullName	BirthDate	BirthTime	DrugNo	DrugName
P10001	Robert Macdonald	1945-11-11	11:00:00	P00001	Chloroquine
P10002	Robert Macdonald	1945-11-11	11:00:00	P00002	Chloroquine
P10003	Robert Macdonald	1945-11-11	11:00:00	P00003	Chloroquine

  

Drug	DrugNo	DrugName	Description	MethodOfAdmin
P00001	P00001	Chloroquine	Chloroquine	Oral
P00002	P00002	Chloroquine	Chloroquine	Oral
P00003	P00003	Chloroquine	Chloroquine	Oral

b) Considering the 1NF, list the partial dependencies and the transitive dependencies; use the notation explained above. (5 points)

a. Partial dependencies:

- patientNo -> fullName, birthDate
- wardNo -> wardName
- drugNo -> drugName, description, methodOfAdmin
- startDate -> finishDate, drugNo, patientNo

b. Transitive dependencies:

- patientNo -> wardNo -> bedNo
- patientNo -> drugNo -> drugName
- drugNo -> dosage -> unitsPerDay
- patientNo -> startDate, drugNo -> finishDate

c) Remove the partial dependencies and show the 2NF relations. (5 points)

2NF					
Patient	FullName	BirthDate	BirthTime	DrugNo	DrugName
P10001	Robert Macdonald	1945-11-11	11:00:00	P00001	Chloroquine
P10002	Robert Macdonald	1945-11-11	11:00:00	P00002	Chloroquine
P10003	Robert Macdonald	1945-11-11	11:00:00	P00003	Chloroquine

  

Drug	DrugNo	DrugName	Description	MethodOfAdmin
P00001	P00001	Chloroquine	Chloroquine	Oral
P00002	P00002	Chloroquine	Chloroquine	Oral
P00003	P00003	Chloroquine	Chloroquine	Oral

d) Remove the transitive dependencies and show the 3NF relations. Make sure to list the PK's and FK's. (10 points)

3NF					
Patient	FullName	BirthDate	BirthTime	DrugNo	DrugName
P10001	Robert Macdonald	1945-11-11	11:00:00	P00001	Chloroquine
P10002	Robert Macdonald	1945-11-11	11:00:00	P00002	Chloroquine
P10003	Robert Macdonald	1945-11-11	11:00:00	P00003	Chloroquine

  

Drug	DrugNo	DrugName	Description	MethodOfAdmin
P00001	P00001	Chloroquine	Chloroquine	Oral
P00002	P00002	Chloroquine	Chloroquine	Oral
P00003	P00003	Chloroquine	Chloroquine	Oral

  

Ward	WardNo	WardName	BedNo
P10001	P10001	Chloroquine	101
P10002	P10002	Chloroquine	102
P10003	P10003	Chloroquine	103