DBMS Normalisation :

Q : **N&N** Hospital is facing problems in its data organization. As database analyst, you have to normalize following N&N Hospital data up to **4NF**. Elaborate each step you perform with logic and state clearly any other **VALID** assumption that you make.

Doc no.	Name	Address	Phone	Department Id	Designation	Charges Per hour	Patient No.	Patient Name	CNIC	Phone	Room No.	Room Type	Bed No.
D1	Dr.Nadeem	Abc 123	0333-123, 042-123	Neurology	Professor	5000	P1	Kahlid	12345-1	042-1	R2	Normal	B1
							P5	Ahmed	12345-2	042-2			
							P7	Anum	12345-3	042-3	Nill		Nill
D2	Dr.Nadeem	Kb13	0334-124, 0300-123	Orthopedic	Professor	5000	P4	Mehmood	12345-4	042-4	R2	Normal	B1
							P7	Anum	12345-3	042-3	R4	Two bed	B5
							P9	Khawar	12345-6	042-5			B7
D4	Dr.Erum	Ak123	0321-123	ENT/ Neurology	Astt. Professor	3000	P10	Tanweer	12345-7	042-6	Nill		Nill
							P1	Khalid	12345-1	042-1	R5	Special	B8
D5	Dr.Hafeez	Nd123	0321-124	Skin/ Orthopedic	Astt. Professor	3000	P12	Sohail	12345-9	042-8	Nill		Nill
							P13	Ahmed	12346-0	042-9	R6	Special	B9

Ans :

1NF :

- It can be seen that the given table is not in first normal form as all the fields are not atomic and fields like Phone are multivalued.
- The functional Dependencies are:
  - (Doc.No.) -> (Name, Address, Designation, Charges Per hour)
  - (Doc.No.) -> (Phone)
  - (Doc.No.) -> (DepartmentId)
  - (Doc.No., PatientNo.) -> (PatientName, CNIC, Phone, RoomNo., RoomType, BedNo.)
  - (PatientNo.) - > (CNIC) [Assuming PatientNo. Can determine CNIC]
- Hence they can be divided as below :

1. Doctor_Table :

DocNo	Name	Address	Designation	Charges Per Hour
D1	Dr. Nadeem	ABC123	Professor	5000
D2	Dr. Nadeem	KB13	Professor	5000
D3	Dr. Erum	AK123	Asst. Professor	3000
D4	Dr. Hafeez	ND123	Asst. Professor	3000

2. Phone_Table :

DocNo.	Phone
D1	0333-123
D1	042-123
D2	0334-124
D2	0300-123
D4	0321-123
D5	0321-124

3. Department_Table :

DocNo.	DepartmentID
D1	Neurology
D2	Orthopeadic
D3	ENT
D3	Neurology
D4	Skin
D4	Orthopeadic

4. Patient_Table :

DocNo	PatientNo	PatientName	CNIC	Phone	RoomNo.	Room Type	BedNo.
D1	P1	Khalid	12345-1	042-1	R2	Normal	B1
D1	P5	Ahmed	12345-2	042-2	R2	Normal	B1
D1	P7	Anum	12345-3	042-3	NA	NA	NA
D2	P4	Mehmood	12345-4	042-4	R2	Normal	B1
D2	P7	Anum	12345-3	042-3	R4	TwoBed	B5
D2	P9	Khawar	12345-6	042-5	R4	TwoBed	B7
D4	P10	Tanweer	12345-7	042-6	NA	NA	NA
D4	P1	Khalid	12345-1	042-1	R5	Special	B8
D5	P12	Sohail	12345-9	042-8	NA	NA	NA
D5	P13	Ahmed	12345-0	042-9	R6	Special	B9

- The Above tables are in 1NF.

2NF :

- A table is said to be in 2NF if there are no partial dependency. A dependency is said to be partial when a filed which is part of candidate key is a determinant for other field.
- In the Patient_Table it can be seen that (DocNo., PatientNo.) is a candidate key and PatientNo. Which is a part of the above candidate key is a determinant of CNIC.
- The functional dependencies are :
  - (Doc.No.) -> (Name, Address, Designation, Charges Per hour)
  - (Doc.No.) -> (Phone)
  - (Doc.No.) -> (DepartmentId)
  - (Doc.No., PatientNo.) -> (PatientName, Phone, RoomNo., RoomType, BedNo.)
  - (PatientNo.) - > (CNIC) [Assuming PatientNo. Can determine CNIC]

- Hence it is not in 2NF. Thus they can be divided as below :

1. Doctor_Table :

DocNo	**Name**	**Address**	**Designation**	**Charges Per Hour**
D1	Dr. Nadeem	ABC123	Professor	5000
D2	Dr. Nadeem	KB13	Professor	5000
D3	Dr. Erum	AK123	Asst. Professor	3000
D4	Dr. Hafeez	ND123	Asst. Professor	3000

2. Phone_Table :

DocNo.	**Phone**
D1	0333-123
D1	042-123
D2	0334-124
D2	0300-123
D4	0321-123
D5	0321-124

3. Department_Table :

DocNo.	DepartmentID
D1	Neurology
D2	Orthopeadic
D3	ENT
D3	Neurology
D4	Skin
D4	Orthopeadic

4. Patient_Table :

DocNo	PatientNo	PatientName	Phone	RoomNo.	Room Type	BedNo.
D1	P1	Khalid	042-1	R2	Normal	B1
D1	P5	Ahmed	042-2	R2	Normal	B1
D1	P7	Anum	042-3	NA	NA	NA
D2	P4	Mehmood	042-4	R2	Normal	B1
D2	P7	Anum	042-3	R4	TwoBed	B5
D2	P9	Khawar	042-5	R4	TwoBed	B7
D4	P10	Tanweer	042-6	NA	NA	NA
D4	P1	Khalid	042-1	R5	Special	B8
D5	P12	Sohail	042-8	NA	NA	NA
D5	P13	Ahmed	042-9	R6	Special	B9

5. CNIC_Table :

PatientNo.	**CNIC**
P1	12345-1
P5	12345-2
P7	12345-3
P4	12345-4
P7	12345-3
P9	12345-6
P10	12345-7
P1	12345-1
P12	12345-9
P13	12345-0

- The above tables are in 2NF.

3NF :

- A table is said to be in third normal form if there are no transitive relations. The relation of the form A->B and B->C is called a transitive ralation.
- In the patient table it can be seen that :
  - (Doc.No., PatientNo.) -> (PatientName, Phone, RoomNo., RoomType, BedNo.)
  - (RoomNo.) -> (RoomType)
- The above relation is a transitive relations. Hen it can be divided as below :

1. Doctor_Table :

DocNo	**Name**	**Address**	**Designation**	**Charges Per Hour**
D1	Dr. Nadeem	ABC123	Professor	5000
D2	Dr. Nadeem	KB13	Professor	5000
D3	Dr. Erum	AK123	Asst. Professor	3000
D4	Dr. Hafeez	ND123	Asst. Professor	3000

2. Phone_Table :

DocNo.	Phone
D1	0333-123
D1	042-123
D2	0334-124
D2	0300-123
D4	0321-123
D5	0321-124

3. Department_Table :

DocNo.	DepartmentID
D1	Neurology
D2	Orthopeadic
D3	ENT
D3	Neurology
D4	Skin
D4	Orthopeadic

4. Patient_Table :

DocNo	PatientNo	PatientName	Phone	RoomNo.	BedNo.
D1	P1	Khalid	042-1	R2	B1
D1	P5	Ahmed	042-2	R2	B1
D1	P7	Anum	042-3	NA	NA
D2	P4	Mehmood	042-4	R2	B1
D2	P7	Anum	042-3	R4	B5
D2	P9	Khawar	042-5	R4	B7
D4	P10	Tanweer	042-6	NA	NA
D4	P1	Khalid	042-1	R5	B8
D5	P12	Sohail	042-8	NA	NA
D5	P13	Ahmed	042-9	R6	B9

5. Room_Table :

RoomNo.	**Room Type**
R2	Normal
R2	Normal
NA	NA
R2	Normal
R4	TwoBed
R4	TwoBed
NA	NA
R5	Special
NA	NA
R6	Special

6. CNIC_Table :

PatientNo.	**CNIC**
P1	12345-1
P5	12345-2
P7	12345-3
P4	12345-4
P7	12345-3
P9	12345-6
P10	12345-7
P1	12345-1
P12	12345-9
P13	12345-0

- So the above tables are in 3NF with Dependencies as below :
  - (Doc.No.) -> (Name, Address, Designation, Charges Per hour)
  - (Doc.No.) -> (Phone)
  - (Doc.No.) -> (DepartmentId)
  - (Doc.No., PatientNo.) -> (PatientName, Phone, RoomNo., BedNo.)
  - (RoomNo.) -> (RoomType)
  - (PatientNo.) - > (CNIC) [Assuming PatientNo. Can determine CNIC]