NORMALIZATION EXERCISE

PROBLEM STATEMENT:

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

Step 1: 1 NF

The above table has two multi-valued attributes, viz-a-viz Phone, and Patient Name. Accordingly, we must have atomic values for all attributes so that the table satisfies conditions for 1 NF. We split the table into three separate tables to remove multi-valued attributes.

1. Attributes: {Doc No., Phone}
2. Attributes: {Doc No., Name, Address, Department ID, Designation, Charges ph}
3. Attributes: {Doc No., Patient No., Patient Name, CNIC, Phone, Room No., Room Type, Bed No.}

1 NF

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

Doc No.	Name	Address	Department ID	Designation	Charges Per Hour
D1	Dr. Nadeem	Abc123	Neurology	Professor	5000
D2	Dr. Nadeem	Kb13	Orthopedic	Professor	5000
D4	Dr. Erum	Ak123	ENT/ Neurology	Astt. Professor	3000
D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Astt. Professor	3000

DocNo	Patient No.	Patient Name	CNIC	Phone	Room No.	Room Type	Bed No.
D1	P1	Kahlid	12345-1	042-1	R2	Normal	B1
D1	P5	Ahmed	12345-2	042-2	R2	Normal	B1
D1	P7	Anum	12345-3	042-3	Nill		Nill
D2	P4	Mehmood	12345-4	042-4	R2	Normal	B1
D2	P7	Anum	12345-3	042-3	R4	Two Bed	B5
D2	P9	Khawar	12345-6	042-5	R4	Two Bed	B7
D4	P10	Tanweer	12345-7	042-6	Nill		Nill
D4	P1	Khalid	12345-1	042-1	R5	Special	B8
D5	P12	Sohail	12345-9	042-8	Nill		Nill
D5	P13	Ahmed	12345-0	042-9	R6	Special	B9

Step 2: 2 NF

Relations having partial dependency are normalized by breaking the table down in multiple relations.

The patient is dependent on the Doctor. The room is dependent on the Patient & Doctor.

2 NF

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

Doc No.	Name	Address	Department ID	Designation	Charges Per Hour
D1	Dr. Nadeem	Abc 123	Neurology	Professor	5000
D2	Dr. Nadeem	Kb 13	Orthopedic	Professor	5000
D4	Dr. Erum	Ak123	ENT/Neurology	Astt. Professor	3000
D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Astt. Professor	3000

Doc No	Patient No
D1	P1
D1	P5
D1	P7
D2	P4
D2	P7
D2	P9
D4	P10
D4	P1
D5	P12
D5	P13

Patient No	Patient Name	CNIC	Phone	Room No.	Room Type	Bed No.
P1	Kahlid	12345-1	042-1	R2	Normal	B1
P5	Ahmed	12345-2	042-2	R2	Normal	B1
P7	Anum	12345-3	042-3	Nill	Nill	Nill
P4	Mehmood	12345-4	042-4	R2	Normal	B1
P7	Anum	12345-3	042-3	R4	Two bed	B5
P9	Khawar	12345-5	042-5	R4	Two bed	B7
P10	Tanweer	12345-6	042-6	Nill	Nill	Nill
P1	Khalid	12345-1	042-1	R5	Special	B8
P12	Sohail	12345-8	042-8	Nill	Nill	Nill
P13	Ahmed	12345-9	042-9	R6	Special	B9

Step 3: 3 NF

In order for the schema to be in 3 NF, Decompose relations till every non-prime attribute of all relations is non-transitively dependent on every key of all derived tables. In our case, we don't have any transitive dependency and hence we don't have any change and the schema is in 3 NF.

3 NF

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

Doc No.	Name	Address	Department ID	Designation	Charges Per Hour
D1	Dr. Nadeem	Abc 123	Neurology	Professor	5000
D2	Dr. Nadeem	Kb 13	Orthopedic	Professor	5000
D4	Dr. Erum	Ak123	ENT/Neurology	Astt. Professor	3000
D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Astt. Professor	3000

Doc No	Patient No
D1	P1
D1	P5
D1	P7
D2	P4
D2	P7
D2	P9
D4	P10
D4	P1
D5	P12
D5	P13

Patient No	Patient Name	CNIC	Phone	Room No.	Room Type	Bed No.
P1	Kahlid	12345-1	042-1	R2	Normal	B1
P5	Ahmed	12345-2	042-2	R2	Normal	B1
P7	Anum	12345-3	042-3	Nill	Nill	Nill
P4	Mehmood	12345-4	042-4	R2	Normal	B1
P7	Anum	12345-3	042-3	R4	Two bed	B5
P9	Khawar	12345-5	042-5	R4	Two bed	B7
P10	Tanweer	12345-6	042-6	Nill	Nill	Nill
P1	Khalid	12345-1	042-1	R5	Special	B8
P12	Sohail	12345-8	042-8	Nill	Nill	Nill
P13	Ahmed	12345-9	042-9	R6	Special	B9

Step 4: BCNF

In order for the schema to be in BCNF, all the determinant must be super key. Hence, we split the relations until we have all dependencies wherein, we have the determinant as a super key.

BCNF

DOC ID	Phone
D1	0333-123
D1	042-123
D2	0334-124
D2	0300-123
D4	0321-123
D5	0321-124

Doc No.	Name	Address	Department ID	Designation	Charges Per Hour
D1	Dr. Nadeem	Abc123	Neurology	Professor	5000
D2	Dr. Nadeem	Kb13	Orthopedic	Professor	5000
D4	Dr. Erum	Ak123	ENT/ Neurology	Astt. Professor	3000
D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Astt. Professor	3000

DocNo	Patient No.	Room No.	Bed No.
D1	P1	R2	B1
D1	P5	R2	B1
D1	P7	Nill	Nill
D2	P4	R2	B1
D2	P7	R4	B5
D2	P9	R4	B7
D4	P10	Nill	Nill
D4	P1	R5	B8
D5	P12	Nill	Nill
D5	P13	R6	B9

Room No.	Room Type
Nill	ND
R2	Normal
R4	Two Bed
R5	Special
R6	Special

Patient No.	Patient Name	CNIC	Phone
P1	Kahlid	12345-1	042-1
P5	Ahmed	12345-2	042-2
P7	Anum	12345-3	042-3
P4	Mehmood	12345-4	042-4
P9	Khawar	12345-6	042-5
P10	Tanweer	12345-7	042-6
P12	Sohail	12345-9	042-8
P13	Ahmed	12345-0	042-9