Normalization In Databases

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: Converting to 1 NF, We Get:

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	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	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	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	12345-5	042-5	R4	Two bed	B7
D4	P10	Tanweer	12345-6	042-6	Nill	Nill	Nill
D4	P1	Khalid	12345-1	042-1	R5	Special	B8
D5	P12	Sohail	12345-8	042-8	Nill	Nill	Nill
D5	P13	Ahmed	12345-9	042-9	R6	Special	B9

A new table has been created for Multi-valued attributes phone number since it is dependent on Doctor number. Patient Number is also a multi-valued attribute. Thus another relation is created and the base table is split into 3 parts.

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

Relations having partial dependency are normalized by breaking it down in multiple relations. Patient No and Dr. No. together for the candidate key however the the details of the patients are only dependent on the Patient No. hence we split.

3NF

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

Decomposing Relations till every non-prime attribute of all relations (tables) is non-transitively dependent on every key of all derived tables and all candidate keys are part of the superkey. However, there are no Transitive dependencies.

BCNF

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

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

Considering the condition that the Room type is functionally dependent on the room no attribute and room no attribute is not a candidate key, we split the table.