

Normalization

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	Null		Null
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			
							P9	Khawar	12345-6	042-5	R4	Two bed	B5
D4	Dr.Erum	Ak123	0321-123	ENT/ Neurology	Asth. Professor	3000	P10	Tanweer	12345-7	042-6	Null		Null
							P1	Khalid	12345-1	042-1	R5	Special	B8
D5	Dr.Hafeez	Nd123	0321-124	Skin/ Orthopedic	Asth. Professor	3000	P12	Sohail	12345-9	042-8	Null		Null
							P13	Ahmed	12346-0	042-9	R6	Special	B9

1 NF								
DocNo	Phone		Doc No.	Name	Address	Department ID	Designation	Charges Per Hour
D1	0333-123		D1	Dr. Nadeem	Abc 123	Neurology	Professor	5000
D1	042-123		D2	Dr. Nadeem	Kb 13	Orthopedic	Professor	5000
D2	0334-124		D4	Dr. Erum	Ak123	ENT/Neurology	Asth. Professor	3000
D2	0300-123		D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Asth. Professor	3000
D4	0321-123							
D5	0321-124							
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	Null	Null	Null	
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	Null	Null	Null	
D4	P1	Khalid	12345-1	042-1	R5	Special	B8	
D5	P12	Sohail	12345-8	042-8	Null	Null	Null	
D5	P13	Ahmed	12345-9	042-9	R6	Special	B9	

1NF - The table should not contain any multivalued attributes. The **phone** attribute and **Patient details attributes (Patient No, Patient Name, CNC, Phone, Room No, Room Type, Bed No)** contain multiple values and need to be split. These attributes are removed and paired with **DocNo** - the candidate key. Finally, three tables are created after 1NF.

2 NF								
DocNo	Phone	Doc No.	Name	Address	Department ID	Designation	Charges Per Hour	
D1	0333-123	D1	Dr. Nadeem	Abc 123	Neurology	Professor	5000	
D1	042-123	D2	Dr. Nadeem	Kb 13	Orthopedic	Professor	5000	
D2	0334-124	D4	Dr. Erum	Ak123	ENT/Neurology	Astt. Professor	3000	
D2	0300-123	D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Astt. Professor	3000	
D4	0321-123							
D5	0321-124							
Doc No	Patient No	Patient No	Patient Name	CNIC	Phone	Room No.	Room Type	Bed No.
D1	P1	P1	Kahlid	12345-1	042-1	R2	Normal	B1
D1	P5	P5	Ahmed	12345-2	042-2	R2	Normal	B1
D1	P7	P7	Anum	12345-3	042-3	Nill	Nill	Nill
D2	P4	P4	Mehmood	12345-4	042-4	R2	Normal	B1
D2	P7	P7	Anum	12345-3	042-3	R4	Two bed	B5
D2	P9	P9	Khawar	12345-5	042-5	R4	Two bed	B7
D4	P10	P10	Tanweer	12345-6	042-6	Nill	Nill	Nill
D4	P1	P1	Khalid	12345-1	042-1	R5	Special	B8
D5	P12	P12	Sohail	12345-8	042-8	Nill	Nill	Nill
D5	P13	P13	Ahmed	12345-9	042-9	R6	Special	B9

2 NF - The table should not contain any partial dependency. **Patient No** and **Doc No** form a candidate key and patient details are dependent only on Patient No. but not on Doc No. Hence, splitting the table.

3NF								
DocNo	Phone	Doc No.	Name	Address	Department ID	Designation	Charges Per Hour	
D1	0333-123	D1	Dr. Nadeem	Abc 123	Neurology	Professor	5000	
D1	042-123	D2	Dr. Nadeem	Kb 13	Orthopedic	Professor	5000	
D2	0334-124	D4	Dr. Erum	Ak123	ENT/Neurology	Astt. Professor	3000	
D2	0300-123	D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Astt. Professor	3000	
D4	0321-123							
D5	0321-124							

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

3NF - There should not be any transitive dependency for 3NF. As there are no transitive dependencies in this table. Hence, no changes.

Note - **Room No.**, **Room Type**, and **Bed No.** cannot be considered for candidate key dependency as they contain **Nill**.

BCNF							
DocNo	Phone	Doc No.	Name	Address	Department ID	Designation	Charges Per Hour
D1	0333-123	D1	Dr. Nadeem	Abc 123	Neurology	Professor	5000
D1	042-123	D2	Dr. Nadeem	Kb 13	Orthopedic	Professor	5000
D2	0334-124	D4	Dr. Erum	Ak123	ENT/Neurology	Astt. Professor	3000
D2	0300-123	D5	Dr. Hafeez	Nd123	Skin/Orthopedic	Astt. Professor	3000
D4	0321-123						
D5	0321-124						
Doc No	Patient No	Patient No	Patient Name	CNIC	Phone	Bed No.	Room No.
D1	P1	P1	Kahlid	12345-1	042-1	B1	R2
D1	P5	P5	Ahmed	12345-2	042-2	B1	R2
D1	P7	P7	Anum	12345-3	042-3	Nill	Nill
D2	P4	P4	Mehmood	12345-4	042-4	B1	R2
D2	P7	P7	Anum	12345-3	042-3	B5	R4
D2	P9	P9	Khawar	12345-5	042-5	B7	R4
D4	P10	P10	Tanweer	12345-6	042-6	Nill	Nill
D4	P1	P1	Khalid	12345-1	042-1	B8	R5
D5	P12	P12	Sohail	12345-8	042-8	Nill	Nill
D5	P13	P13	Ahmed	12345-9	042-9	B9	R6

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

BCNF - A database table is in BCNF if and only if there are no non-trivial functional dependencies of attributes on anything other than a superset of a candidate key. **Room Type** is dependent on **Room No** which is not a candidate key and it is allowed in BCNF.