

## 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	Nil		Nil
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		B5
							P9	Khawar	12345-6	042-5		Two bed	B7
D4	Dr.Erum	Ak123	0321-123	ENT/ Neurology	Asth. Professor	3000	P10	Tanweer	12345-7	042-6	Nil		Nil
							P1	Khalid	12345-1	042-1	R5	Special	B8
D5	Dr.Hafeez	Nd123	0321-124	Skin/ Orthopedic	Asth. Professor	3000	P12	Sohail	12345-8	042-8	Nil		Nil
							P13	Ahmed	12346-0	042-9	R6	Special	B9

### Step 1: Converting to 1 NF, We Get:

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	Nil	Nil	Nil	
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	Nil	Nil	Nil	
D4	P1	Khalid	12345-1	042-1	R5	Special	B8	
D5	P12	Sohail	12345-8	042-8	Nil	Nil	Nil	
D5	P13	Ahmed	12345-9	042-9	R6	Special	B9	

**Description:** 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 for each **Doctor Number**. Thus another relation is created and the base table is split into 3 parts.

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	Nil	Nil	Nil
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	Nil	Nil	Nil
D4	P1	P1	Khalid	12345-1	042-1	R5	Special	B8
D5	P12	P12	Sohail	12345-8	042-8	Nil	Nil	Nil
D5	P13	P13	Ahmed	12345-9	042-9	R6	Special	B9

**Description-** 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 details of the patients are only dependent on the Patient No. hence we split.

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	Nil	Nil	Nil
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	Nil	Nil	Nil
D4	P1	P1	Khalid	12345-1	042-1	R5	Special	B8
D5	P12	P12	Sohail	12345-8	042-8	Nil	Nil	Nil
D5	P13	P13	Ahmed	12345-9	042-9	R6	Special	B9

**Description-** 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 . Thus no change takes place.

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	Nil	Nil
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	Nil	Nil
D4	P1		P1	Khalid	12345-1	042-1	B8	R5
D5	P12		P12	Sohail	12345-8	042-8	Nil	Nil
D5	P13		P13	Ahmed	12345-9	042-9	B9	R6
Room No.	Room Type							
Nil	ND							
R2	Normal							
R4	Two Bed							
R5	Special							
R6	Special							

**Description-** 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.