

* Normalise the above table upto BCNF.
* Identify and mention the appropriate dependencies in each level of normalization.
* After every normalization level, illustrate the resulting tables with all values
* Elaborate each step clearly and mention any assumption you make to solve the problem.
* Answers can either be submitted as scanned copies of normalization done on paper or as documents where the tables are drawn using tools

**Solutions**

For the 1st NF, which states that a table does not contain any composite or multi-valued attribute. But here, we can see that there are multiple values in Phone and Patient no. column of the customer table so, the table is not in 1NF. To make the table in 1NF we have to split the table in 3 parts(3 tables).

1st table will be of Doctor having columns – Doc no. , Name, Address, Department Id, Designation and Charges Per Hour. Here Doc no. will be the Primary Key.

Dependency - Attributes such as Name, Address, Department Id, Designation and Charges Per Hour is dependent on Doc no.

Prime Attributes : Doc no

Non- Prime Atrributes : Name, Address, Department Id, Designation and Charges Per Hour

2nd Table will be of having Doctor Phone number which will have columns like – Doc No. and Phone no. , Here Doc no. and Phone no. will be the Primary Key

Prime Attributes : Doc no , Phone no.

Non- Prime Attributes : None

3rd table will be of Patients having columns – Doc No. , Patient no. , Patient Name, CNIC, Phone, Room no. , Room type, Bed no. Here Primary key will be a composite key i.e Doc. No. and Patient No.

Dependency – Attributes such as Patient Name, CNIC, Phone, Room no. , Room type, Bed no is dependent on Doc no and Patient no.

Prime Attributes : Doc no , Patient no.

Non- Prime Attributes : Patient Name, CNIC, Phone, Room no. , Room type, Bed no.

Table 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Doc No. | Name | Address | Department Id | Designation | Charges Per Hour |
| D1 | Dr. Nadeem | Abc 123 | Neurology | Professor | 5000 |
| D2 | Dr. Nadeem | Kb13 | Orthopedic | Professor | 5000 |
| D4 | Dr. Erum | Ak123 | ENT/Neurology | Asstt. Professor | 3000 |
| D5 | Dr. Hafeez | Nd123 | Skin/ Orthopedic | Asstt. Professor | 3000 |

Table 2

|  |  |
| --- | --- |
| Doc No. | Phone |
| D1 | 0333-123 |
| D1 | 042-123 |
| D2 | 0334-124 |
| D2 | 0300-123 |
| D4 | 0321-123 |
| D5 | 0321-124 |

Table 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Doc No. | Patient No. | Patient Name | CNIC | Phone | Room no. | Room Type | Bed no. |
| D1 | P1 | Khalid | 12345-1 | 042-1 | R2 | Normal | B1 |
| D1 | P5 | Ahmed | 12345-2 | 042-2 | R2 | Normal | Nil |
| 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 | 12345-6 | 042-4 | R4 | Two bed | B7 |
| D4 | P10 | Tanweer | 12345-7 | 042-5 | Nil | Nil | Nil |
| D4 | P1 | Khalid | 12345-1 | 042-1 | R5 | Special | B8 |
| D5 | P12 | Sohail | 12345-9 | 042-8 | Nil | Nil | Nil |
| D5 | P13 | Ahmen | 12346-0 | 042-9 | R6 | Special | B9 |

Now, coming to 2NF which states that there should no partial dependency but in table 3 there is a partial dependency. Patient name, CNIC, Phone are dependent on Patient no. only. These columns does not dependent on Doc No., So to make it in 2NF we need to split the table 3 in to

2 tables let name them table 4 and table 5.

In table 4 will be having columns – Doc no. , Patient no., Room no., Room Type, Bed no. , here the primary key will be the combination of Doc no. and Patient no.

Dependency - Room no., Room Type, Bed no. is dependent on Doc no. & Patient no.

Prime Attributes : Doc no. , Patient no.

Non Prime Attributes : Room no., Room Type, Bed no.

In table 5 will be having columns – Patient no. , Patient Name, CNIC, Phone . Here the Primary key will be Patient no.

Dependency - Patient Name, CNIC, Phone is dependent on Patient no.

Prime Attributes : Patient no.

Non Prime Attributes : Patient Name, CNIC, Phone

Table 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Doc No. | Patient no. | Room no. | Room Type | Bed no. |
| D1 | P1 | R2 | Normal | B1 |
| D1 | P5 | R2 | Normal | Nil |
| D1 | P7 | Nil | Nil | Nil |
| D2 | P4 | R2 | Normal | B1 |
| D2 | P7 | R4 | Two Bed | B5 |
| D2 | P9 | R4 | Two Bed | B7 |
| D4 | P10 | Nil | Nil | Nil |
| D4 | P1 | R5 | Special | B8 |
| D5 | P12 | Nil | Nil | Nil |
| D5 | P13 | R6 | Special | B9 |

Table 5

|  |  |  |  |
| --- | --- | --- | --- |
| Patient No. | Patient Name | CNIC | Phone |
| P1 | Khalid | 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 | Ahmen | 12345-0 | 042-9 |

Now coming to 3NF, which states that there should be no transitive dependency, in table 1

there exists a transitive dependency that column Designation can determine the column Charges per Hour, Or , we can say that Charges per hour is dependent on Designation and Designation is dependent on Doc no. So, we need to remove this by breaking table in to 2 parts lets name them table 6 and table 7.

So, Table 6 will have column – Doc no. , Name, Address, Department Id, Designation. Here the Primary key will be Doc no.

Dependency - : Name, Address, Department Id, Designation is dependent on Doc no.

Prime Attributes : Doc no.

Non Prime Attributes : Name, Address, Department Id, Designation

Table 7 will have column – Designation and Charges Per Hour . Here the Primary Key will be Designation.

Dependency - Charges Per Hour is dependent on Designation.

Prime Attributes : Designation

Non Prime Attributes : Charges Per Hour

Table 6

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Doc no. | Name | Address | Department Id | Designation |
| D1 | Dr. Nadeem | Abc 123 | Neurology | Professor |
| D2 | Dr. Nadeem | Kb123 | Orthopedic | Professor |
| D4 | Dr. Erum | Ak123 | ENT/ Neurology | Asstt. Professor |
| D5 | Dr. Hafeez | Nd123 | Skin/Orthopedic | Asstt. Professor |

Table 7

|  |  |
| --- | --- |
| Designation | Charge Per Hour |
| Professor | 5000 |
| Asstt. Professor | 3000 |

In table 4 we have also a transitive dependency that the Room Type is dependent on Room no. So, we need to remove this also.

In order to remove it we can break the table 4 in two parts lets, name them table 8 and table 9

Table 8 will have columns - Room no. and Room Type. Here, the Primary Key is Room no.

Dependency - Room Type is dependent on Room no.

Prime Attributes : Room no.

Non Prime Attributes : Room Type

Table 9 will have columns – Doc No. , Patient no. , Room no. and Bed no.

Here the Primary key will be Doc No. and Patient no.

Dependency - Room no. and Bed no. is dependent on both Doc No. & Patient no.

Prime Attributes : Doc No. , Patient no.

Non Prime Attributes : Room no. and Bed no.

Table 8

|  |  |
| --- | --- |
| Room No. | Room Type |
| R2 | Normal |
| R4 | Two Bed |
| R5 | Special |
| R6 | Special |

Table 9

|  |  |  |  |
| --- | --- | --- | --- |
| Doc No. | Patient No. | Room no. | Bed no. |
| D1 | P1 | R2 | B1 |
| D1 | P5 | R2 | B1 |
| D1 | P7 | Nil | Nil |
| D2 | P4 | R2 | B1 |
| D2 | P7 | R4 | B5 |
| D2 | P9 | R4 | B7 |
| D4 | P10 | Nil | Nil |
| D4 | P1 | R5 | B8 |
| D5 | P12 | Nil | Nil |
| D5 | P13 | R6 | B9 |

Now , For BCNF which states that every determinant is in the form of Candidate key or Super key.

Here, In each of the table 2,5,6,7,8 and 9 every determinant is in the form of Candidate key or Super.

Hence , they are in BCNF form.