NORMALIZATION PROOFS

- **Minimal FD set for all relation and Proof that Relations are in BCNF:-**

1) **Admin** (Admin_id, name, role, email, contact, joining_date, working_status)

Admin_id -> {Name, Role, Email, contact, Joining_date, Working_status**}**
This is the Minimal FD set for the Relation Admin.

Key:- Admin_id

As,Admin_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

2) **Doctor** (License_no, Name, Contact, Joining_date, Address, Leaving_date, Salary, Role, Gender, Weekday, Shifts, Max_appointments_per_day, Charge,Superviser_id)

License_no-> {Name, Contact, Joining_date, Address, Leaving_date, Salary, Role, Gender, Weekday, Shifts, Max_appointments_per_day, Charge,Superviser_id**}**
This is the Minimal FD set for the Relation Doctor.

Key:- License_no

As,License_no, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

3) **Staff** (St_id, Name, Contact, Joining_date, Address, Leaving_date, Salary, Role, Gender, Weekday, Shifts,Superviser_id,Doc_id,Dep_id)

St_id -> {Name, Contact, Joining_date, Address, Leaving_date, Salary, Role, Gender, Weekday, Shifts,Superviser_id,Doc_id,Dep_id**}**
This is the Minimal FD set for the Relation Doctor.

Key:- St_id

As,St_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

4) **Patient** (Pat_id, Name, Email, Contact, Address, Age, Gender, Weight, Height, Blood_grp)

Pat_id -> {Name, Email, Contact, Address, Age, Gender, Weight, Height, Blood_grp**}**

This is the Minimal FD set for the Relation Patient.

Key:- Pat_id

As,Pat_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

5) **Appointments** (Appo_id, Date_time, Status, Doctor_id , Patient_id)

Appo_id -> { Date_time, Status, Doctor_id , Patient_id**}**

This is the Minimal FD set for the Relation Appointment.

Key:- Appo_id

As,Appo_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

6) **Patient_Report** (Report_id,Comment, Date, Pat_id,Diseases)

Report_id-> {Comment, Date, Pat_id,Diseases**}**

This is the Minimal FD set for the Relation Patient_Report.

Key:- Report_id

As,Report_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

7) **Lab_report** (Report_id,Lab_test_id,Result_of_test)

{Report_id,Lab_test_id} -> {Result_of_test**}**

This is the Minimal FD set for the Relation Lab_report .

Key:- {Report_id,Lab_test_id}

As,{Report_id,Lab_test_id}, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set.
Thus, it in the **BCNF** Form.

8) **Medicine_patient** (Report_id,Med_id,Qty_bought)

{Report_id,Med_id} -> {Qty_bought**}**
This is the Minimal FD set for the Relation Medicine_patient.

Key:- {Report_id,Med_id}

As,{Report_id,Med_id}, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set.
Thus, it in the **BCNF** Form.

9) **Medicine**(Med_id, Name, Price, Qty_in_stock)

Med_id -> {Name, Price, Qty_in_stock**}**
This is the Minimal FD set for the Relation Medicine.

Key:- Med_id

As,Med_id , being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set.
Thus, it in the **BCNF** Form.

10) **Lab_Test** (Lab_test_id, Lab_test_name, Lab_no, price)

Lab_test_id -> {Lab_test_name, Lab_no, price**}**
This is the Minimal FD set for the Relation Lab_Test .

Key:- Lab_test_id

As,Lab_test_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set.
Thus, it in the **BCNF** Form.

11) **Room** (Room_no, No_of_beds, Room_type, Room_charge)

Room_no -> {No_of_beds, Room_type, Room_charge**}**
This is the Minimal FD set for the Relation Room.

Key:- Room_no

As,Room_no, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

12) **Bed** (Room_no ,Bed_no, Status (Available/Not Available))

{Room_no,Bed_no}-> { Status **}**

This is the Minimal FD set for the Relation Bed.

Key:- Room_no ,Bed_no

As,Room_no ,Bed_no, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

13) **Allocate** (Room_id,Bed_no,Pat_id,Allocation_Date,Discharge_date)

{Room_no,Bed_no,Pat_id,Allocation_date} -> {Discharge_date**}**

This is the Minimal FD set for the Relation Allocate.

Key:- Room_id,Bed_no,Pat_id,Allocation_Date

As,Room_id,Bed_no,Pat_id,Allocation_Date, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

14) **Bill** (Invoice_no, Start_date,End_date, Status, Due_date, Total_charge, Total_amount,Patient_id)

Invoic_no -> {Start_date,End_date, Status, Due_date, Total_charge, Total_amount,Patient_id**}**

This is the Minimal FD set for the Relation Bill.

Key:- Invoice_no

As,Invoice_no, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

15) **Patient_Insurance** (Ins_no, Provider_name, Ins_type, End_date, Percentage_of_ins, Patient_id)

Ins_no -> {Provider_name, Ins_type, End_date, Percentage_of_ins**}**

This is the Minimal FD set for the Relation Patient_Insurance .

Key:- Ins_no

As,Ins_no, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

16) **Driver** (Licence_id, Name, Contact, Joining_date,Address, Leaving_date,Salary,Gender,Shift)

Licence_id -> {Name, Contact, Joining_date,Address, Leaving_date,Salary,Gender,Shift**}**

This is the Minimal FD set for the Relation Driver.

Key:- Licence_id

As,Licence_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

17) **Ambulance** (No_plate,status)

No_plate -> {status**}**

This is the Minimal FD set for the Relation Ambulance.

Key:- No_plate

As,No_plate, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

18) **Ambulance-Service** (Patient_id,No_plate,Date-time,Pick-up-location)

{Pat_id,no_plate} -> {Date-time,Pick-up-location**}**

This is the Minimal FD set for the Relation Ambulance-Service.

Key:- Pat_id,No_plate

As,Pat_id,No_plate, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

19) **Department** (Department_id, name,Superviser_id)

Department_id -> {name**}**

This is the Minimal FD set for the Relation Department.

Key:- Department_id

As,Department_id, being the key determines every attribute in the relation, it is on the left side of all FDs in Minimal FD set. Thus, it in the **BCNF** Form.

IMPORTANT QUERIES

1. **Which hospital department has received the most patients over a specific time.**

```
SELECT
    d.Department_id,
    dept.Name AS Department_Name,
    COUNT(DISTINCT a.Patient_id) AS Total_Patients
FROM Appointments a
JOIN Doctor d ON a.Doctor_id = d.License_no
JOIN Department dept ON d.Department_id = dept.Department_id
WHERE a.Date_time BETWEEN '2024-04-01' AND '2025-04-01' -- <-- adjust
as needed
GROUP BY d.Department_id, dept.Name
ORDER BY Total_Patients DESC
LIMIT 1;
```

2. **Get the patient's entire(Pat_id = 45001) medical history, current test findings, and prescriptions**

```
SELECT
    p.Pat_id,
    p.Name AS Patient_Name,
    pr.Report_id,
    pr.Comment,
    pr.Date AS Report_Date,
    lt.Lab_test_name,
    lr.Result_of_test,
    m.Name AS Medicine_Name,
    mp.Qty_bought
FROM Patient p
LEFT JOIN Patient_Report pr ON p.Pat_id = pr.Pat_id
LEFT JOIN Lab_report lr ON pr.Report_id = lr.Report_id
LEFT JOIN Lab_Test lt ON lr.Lab_test_id = lt.Lab_test_id
LEFT JOIN Medicine_patient mp ON pr.Report_id = mp.Report_id
LEFT JOIN Medicine m ON mp.Med_id = m.Med_id
WHERE p.Pat_id = 45001;
```

3. **Verify insurance coverage for pending bills**

```
SELECT b.Invoice_no, p.Name AS Patient_Name, b.Total_amount AS
Bill_Amount,
      pi.Provider_name, pi.Percentage_of_ins,
      (b.Total_amount * pi.Percentage_of_ins/100) AS
Insurance_Coverage,
      (b.Total_amount - (b.Total_amount * pi.Percentage_of_ins/100)) AS
Patient_Responsibility
FROM Bill b
JOIN Patient p ON b.Patient_id = p.Pat_id
JOIN Patient_Insurance pi ON p.Pat_id = pi.Patient_id
WHERE b.Status = 'Pending'
AND pi.End_date >= CURRENT_DATE;
```