Proofs that relations are in BCNF

1. **USER** relation :-

   - Attributes :-
     USER {User_ID , Pan_No. , Email_ID , Name , Contact_No. , Available_Balance }

   - Functional Dependencies :-
     User_ID → Pan_No.
     User_ID → Email_ID
     User_ID → Name
     User_ID → Contact_No.
     User_ID → Available_Balance
     Pan_No. → User_ID
     Email_ID → User_ID

     Let X = {User_ID} or {Pan_No} or {Email_ID}
     X^+ = {User_ID , Pan_No. , Email_ID , Name , Contact_No. , Available_Balance }

     Such that **Primary Key = {User_ID} or {Pan_No.} or {Email_ID}**

     The determinant side of minimal FD set for the relation 'USER' is {User_ID , Pan_No. , Email_ID}, which are the Candidate Keys of this relation. So that **"USER" is in BCNF**.

2. **Account** relation :-

   - Attributes :-
     Account {Account_No , Bank_Name , IFSC , User_ID}

   - Functional Dependencies :- Account_No → IFSC
     Account_No → User_ID
     IFSC → Bank_Name

Let X = Account_No
X^+ = {Account_No , Bank_Name , IFSC , User_ID}

Such that **Primary Key = Account_No**

Here as we can see in last FD violates BCNF as determinant is not key. It also violates 3NF as last FD dependent is not prime attributes .
The above given relation is in 2NF it satisfies transitivity.
To convert this into BCNF we here do "LossLess Decomposition".

Account	**Bank_Info**
❖ Attributes :- Account {Account_No , IFSC , User_ID}	❖ Attributes :- Account { IFSC ,Bank_Name }
❖ Functional Dependencies :- Account_No → IFSC Account_No → User_ID Such that **Primary Key = Account_No**	❖ Functional Dependencies :- IFSC → Bank_Name Such that **Primary Key = IFSC**

Above in both relation determinant is key , such that our relation becomes in BCNF.

3. **Transactions** relation :-

   ❖ Attributes :-
   Transactions {Transaction_ID , Transaction_Time , User_ID}

   ❖ Functional Dependencies :-
   Transaction_ID → Transaction_Time
   Transaction_ID → User_ID

   Let X = Transaction_ID

X^+ = {Transaction_ID , Transaction_Time , User_ID}

Such that **Primary Key = Transaction_ID**

The determinant of all the FD's in the minimal set of FD's for the relation 'Transactions' is Transaction_ID , which is the primary Key of this relation. Such that **"Transactions" is in BCNF**.

4. **Bank_Wallet** relation :-

   - Attributes :-
     Bank_Wallet { Transaction_ID , Bank_Acc_No , Amount , Transaction_Type}

   - Functional Dependencies :-
     Transaction_ID → Bank_Acc_No
     Transaction_ID → Amount
     Transaction_ID → Transaction_Type

     Let X = Transaction_ID
     X^+ = { Transaction_ID , Bank_Acc_No , Amount , Transaction_Type}

     Such that **Primary Key = Transaction_ID**

     The determinant of all the FD's in the minimal set of FD's for the relation 'Bank_Wallet' is Transaction_ID , which is the primary Key of this relation. Such that **"Bank_Wallet" is in BCNF**.

5. **Wallet_Stock** relation :-

   - Attributes :-
     Wallet_Stock {Transaction_ID , Stock_Symbol , Order_Type , Qty , Price , Order_ID}

   - Functional Dependencies :-

Transaction_ID → Stock_Symbol
Transaction_ID → Order_Type
Transaction_ID → Qty
Transaction_ID → Price
Transaction_ID → Order_ID

Let X = Transaction_ID
X^+ = {Transaction_ID , Stock_Symbol , Order_Type , Qty , Price , Order_ID}

Such that **Primary Key = Transaction_ID**

The determinant of all the FD's in the minimal set of FD's for the relation 'Wallet_Stock' is Transaction_ID , which is the primary Key of this relation. Such that **"Wallet_Stock" is in BCNF.**

6. **Holding Histroy** relation :-

- Attributes :-
  Holding Histroy {User_ID , Transaction_ID , Purchase_Time_Stamp , Sold_Time_Stamp , Sold Price , Bought Price ,Qty }

- Functional Dependencies :-
  Transaction_ID → Purchase_Time_Stamp
  Transaction_ID → Sold_Time_Stamp
  Transaction_ID → Sold Price
  Transaction_ID → Bought Price
  Transaction_ID → Qty
  Transaction_ID → User_ID

  Let X = Transaction_ID
  X^+ = {User_ID , Transaction_ID , Purchase_Time_Stamp , Sold_Time_Stamp , Sold Price , Bought Price ,Qty }

  Such that **Primary Key = Transaction_ID**

The determinant of all the FD's in the minimal set of FD's for the relation 'Holding History' is Transaction_ID, which is the primary Key of this relation. Such that **"Holding History" is in BCNF.**

7. **Orders** relation :-

- Attributes :-
  Orders {Order_ID , Order_time , Order_type , Trading_type, Price , Qty , Status , User_ID , Stock_Symbol}

- Functional Dependencies :-
  Order_ID → Order_time
  Order_ID → Order_type
  Order_ID → Trading_type
  Order_ID → Price
  Order_ID → Status
  Order_ID → User_ID
  Order_ID → Stock_Symbol

  Let X = Order_ID
  X^+ = {Order_ID , Order_time , Order_type , Trading_type, Price , Qty , Status , User_ID , Stock_Symbol}

  Such that **Primary Key =** Order_ID

  The determinant of all the FD's in the minimal set of FD's for the relation 'Orders' is Order_ID , which is the primary Key of this relation. Such that **"Orders" is in BCNF.**

8. **Watchlist** relation :-

- Attributes :-
  Watchlist {User_ID , Stock_Symbol}

  Here , Primary Key = {User_ID , Stock_Symbol }

According to thorem , All attributes of the relation are key such that **"Watchlist" is in BCNF.**

9. **Holding** relation :-

- Attributes :-
  Holding {User_ID , Stock_Symbol , Purchase_Time , Buy_Price , Qty}

- Functional Dependencies :-
  {User_ID , Stock_Symbol , Purchase_Time} → Buy_Price
  {User_ID , Stock_Symbol , Purchase_Time} → Qty

  Let X = {User_ID , Stock_Symbol , Purchase_Time}
  X^+ = {User_ID , Stock_Symbol , Purchase_Time , Buy_Price , Qty}

  Such that **Primary Key = { User_ID , Stock_Symbol , Purchase_Time }**
  The determinant of all the FD's in the minimal set of FD's for the relation 'Holding' is {User_ID , Stock_Symbol , Purchase_Time }, which is the primary Key of this relation. Such that **"Holding" is in BCNF.**

10. **Stocks** relation :-

- Attributes :-
  Stocks {Stock_Symbol , SName , SType , Highest , Lowest , Exchange , CIN}

- Functional Dependencies :-
  Stock_Symbol → SName
  Stock_Symbol → SType
  Stock_Symbol → Highest
  Stock_Symbol → Lowest
  Stock_Symbol → Exchange

Stock_Symbol → CIN

Let X = {Stock_Symbol}
X^+ = {Stock_Symbol , SName , SType , Highest , Lowest , Exchange, CIN}

Such that **Primary Key = Stock_Symbol**

The determinant of all the FD's in the minimal set of FD's for the relation 'Stocks' is Stock_Symbol , which is the primary Key of this relation. Such that **"Stocks" is in BCNF.**

11. **Stock_History** relation :-

- Attributes :-
  Stock_History {Stock_Symbol , Time_Stamp , Price , Open_Price , Previous Close , Inc/Dec , Volume}

- Functional Dependencies :-
  {Stock_Symbol , Time_Stamp} → Price
  {Stock_Symbol , Time_Stamp} → Open_Price
  {Stock_Symbol , Time_Stamp} → Previous Close
  {Stock_Symbol , Time_Stamp} → Inc/Dec
  {Stock_Symbol , Time_Stamp} → Volume

  Let X = {Stock_Symbol , Time_Stamp}
  X^+ = {Stock_Symbol , Time_Stamp , Price , Open_Price , Previous Close , Inc/Dec , Volume}

  Such that **Primary Key = {Stock_Symbol , Time_Stamp}**

  The determinant of all the FD's in the minimal set of FD's for the relation 'Stock_History' is {Stock_Symbol , Time_Stamp} , which is the primary Key of this relation. Such that **"Stock_History" is in BCNF.**

12. **Stock_Group** relation :-

- Attributes :-
  Stock_Group {Group_symbol , Group_Name , Lowest , Highest ,Stock_Exchange}

- Functional Dependencies :-
  Group_symbol → Lowest
  Group_symbol → Highest
  Group_symbol → Stock_Exchange
  Group_symbol → Group_Name
  Group_Name →Group_symbol

  Let X = Group_symbol or Group_Name
  X^+ = { Group_symbol , Group_Name , Lowest , Highest , Price , Open Price , Close Price , Stock_Exchange}

  Such that **Primary Key = { Group_symbol } or { Group_Name }**

  The determinant of all the FD's in the minimal set of FD's for the relation 'Stock_Group' is Group_symbol and Group_Name , which is the Candidate Key of this relation. Such that **"Stock_Group" is in BCNF.**

13. **Stock_Group_History** relation :-

- Attributes :-
  Stock_Group_History {Group_symbol, Time_Stamp , Inc/Dec , Open_Price , Close_Price , Price}

- Functional Dependencies :-
  {Group_symbol, Time_Stamp} → Inc/Dec
  {Group_symbol, Time_Stamp} → Open_Price
  {Group_symbol, Time_Stamp} → Close_Price
  {Group_symbol, Time_Stamp} → Price

  Let X = {Group_symbol, Time_Stamp}
  X^+ = {Group_symbol, Time_Stamp , Inc/Dec , Open_Price ,

Close_Price, Price}

Such that **Primary Key = {Group_symbol, Time_Stamp}**

The determinant of all the FD's in the minimal set of FD's for the relation 'Stock_Group_History' is {Group_symbol, Time_Stamp} , which is the primary Key of this relation. Such that **"Stock_Group_History" is in BCNF.**

14. **MemberOf** relation :-

- Attributes :-
  MemberOf {Stock_Symbol , Group_Symbol}

  Here , Primary Key = {Stock_Symbol , Group_Symbol}
  According to thorem , All attributes of the relation are key such that **"MemberOf" is in BCNF.**

15. **Company** relation :-

- Attributes :-
  Company {CIN , CName , CEO , Market_Capital , Revenue}

- Functional Dependencies :-
  CIN → CName
  CIN → CEO
  CIN → Market_Capital
  CIN → Revenue

  Let X = CIN
  X^+ = {CIN , CName , CEO , Market_Capital , Revenue}

  Such that **Primary Key = CIN**

  The determinant of all the FD's in the minimal set of FD's for the relation 'Company' is CIN , which is the primary Key of this relation. Such that **"Company" is in BCNF.**

16. **Sector** relation :-

- Attributes :-
  Sector {Sector_Name , CIN}

  Here , Primary Key = {Sector_Name , CIN}
  According to theorem , All attributes of the relation are key such that **"Sector" is in BCNF.**

17. **IPO** relation :-

- Attributes :-
  IPO {IPO_Name , Open_Date , CIN , Issue Price , Close_Date, Lot Size , Issue Price , Minimum Invest , Listing_Date}
- Functional Dependencies :-
  IPO_Name → CIN
  IPO_Name → Open_Date
  IPO_Name → Issue Price
  IPO_Name → Close Date
  IPO_Name → Lot Size
  IPO_Name → Issue Price
  IPO_Name → Minimum Invest
  IPO_Name → Listing Date

  Let X = IPO_Name
  X^+ = {IPO_Name , Open_Date , CIN , Issue Price , Close Date , Lot Size , Issue Price , Minimum Invest , Listing Date}

  Such that **Primary Key = IPO_Name**

  The determinant of all the FD's in the minimal set of FD's for the relation 'IPO' is IPO_Name ,which is the primary Key of this relation. Such that **"IPO" is in BCNF.**

18. **News** relation :-

- Attributes :-
  News {CIN , Title , Description}

- Functional Dependencies :-

  {CIN , Title} → Description

  Let X = {CIN , Title}
  X^+ = {CIN , Title, Description}

  Such that **Primary Key = {CIN , Title}**

  The determinant of all the FD's in the minimal set of FD's for the relation 'News' is {CIN , Title}, which is the primary Key of this relation. Such that **"News" is in BCNF.**