Proofs that relations are in BCNF

1. **USER** relation :-

   ❖ Attributes :-
   USER {User_ID , Pan_No. , Email_ID , Name , Contact_No. , Hold_Balance , Availabel_Balance , Blocked_Balance}

   ❖ Functional Dependencies :-
   User_ID → Pan_No.
   User_ID → Email_ID
   User_ID → Name
   User_ID → Contact_No.
   User_ID → Hold_Balance
   User_ID → Availabel_Balance
   User_ID → Blocked_Balance
   Pan_No. → User_ID
   Email_ID → User_ID

   Let X = {User_ID , Pan_No. , Email_ID}
   X^+ = {User_ID , Pan_No. , Email_ID , Name , Contact_No. , Hold_Balance , Availabel_Balance , Blocked_Balance}

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

   The left side of all the FD's in the minimal set of FD's for the relation 'USER' is {User_ID , Pan_No. , Email_ID}, which is the primary Key of this relation. Such 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} ❖ Functional Dependencies :- Account_No → IFSC Account_No → User_ID	❖ Attributes :- Account { IFSC ,Bank_Name } ❖ Functional Dependencies :- IFSC → Bank_Name

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 left side 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 left side 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 s, 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 left side 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 , To Time_Stamp , From Time_Stamp , Sold Price , Baught Price , Profit/Loss , Amount}

❖ Functional Dependencies :-
{User_ID , Transaction_ID} → To Time_Stamp
{User_ID , Transaction_ID} → From Time_Stamp
{User_ID , Transaction_ID} → Sold Price
{User_ID , Transaction_ID} → Baught Price
{User_ID , Transaction_ID} → Profit/Loss
{User_ID , Transaction_ID} → Amount

Let X = {User_ID , Transaction_ID}
X^+ = {User_ID , Transaction_ID , To Time_Stamp , From Time_Stamp , Sold Price , Baught Price , Profit/Loss , Amount}

Such that **Primary Key = {User_ID , Transaction_ID}**

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

7. **Order** relation :-

❖ Attributes :-
Order {Order_ID , Order_time , Stop_Price , Status , User_ID , Stock_Symbol}

❖ Functional Dependencies :-
Order_ID → Order_time
Order_ID → Stop_Price
Order_ID → Status
Order_ID → User_IDOrder_ID → Stock_Symbol

Let X = Order_ID
X^+ = {Order_ID , Order_time , Stop_Price , Status , User_ID , Stock_Symbol}

Such that **Primary Key** = Order_ID

The left side of all the FD's in the minimal set of FD's for the relation 'Order' is Order_ID , which is the primary Key of this relation. Such that **"Order" 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 , Invested_Price , Qty}

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

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

Such that **Primary Key = { User_ID , Stock_Symbol , Purchase_Time }**
The left side 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 , Name , Type , Highest , Lowest , Exchange , CIN}

❖ Functional Dependencies :-
Stock_Symbol → Name
Stock_Symbol → Type
Stock_Symbol → Highest
Stock_Symbol → Lowest
Stock_Symbol → Exchange
Stock_Symbol → CIN

Let X = Stock_Symbol
X^+ = {Stock_Symbol , Name , Type , Highest , Lowest , Exchange , CIN}

Such that **Primary Key = Stock_Symbol**

The left side 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 left side 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_Name , Lowest , Highest , Price , Open Price , Close Price , Stock_Exchange}

❖ Functional Dependencies :-
Group_Name → Lowest
Group_Name → Highest
Group_Name → Price
Group_Name → Open Price
Group_Name → Close Price
Group_Name → Stock_Exchange

Let X = Name
X^+ = {Name , Lowest , Highest , Price , Open Price , Close Price , Stock_Exchange}

Such that **Primary Key = Group_Name**

The left side of all the FD's in the minimal set of FD's for the relation 'Stock_Group' is Group_Name , which is the primary Key of this relation. Such that **"Stock_Group" is in BCNF.**

13. **Stock_Group_History** relation :-

   ❖ Attributes :-
   Stock_Group_History {Group_Name , Time_Stamp , Inc/Dec , Open Price , Previous Close , Price}

   ❖ Functional Dependencies :-
   {Group_Name , Time_Stamp} → Inc/Dec
   {Group_Name , Time_Stamp} → Open Price
   {Group_Name , Time_Stamp} → Previous Close
   {Group_Name , Time_Stamp} → Price

   Let X = {Group_Name , Time_Stamp}
   X^+ = {Group_Name , Time_Stamp , Inc/Dec , Open Price , Previous Close , Price}

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

   The left side of all the FD's in the minimal set of FD's for the relation 'Stock_Group_History' is {Group_Name , 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_Name}

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

15. **Company** relation :-

   ❖ Attributes :-
   Company {CIN , Name , CEO , Market_Capital , Revenue}

   ❖ Functional Dependencies :-
   CIN → Name
   CIN → CEO
   CIN → Market_Capital
   CIN → Revenue

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

   Such that **Primary Key = CIN**

   The left side 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 thorem , 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 , Open_Date}**

The left side of all the FD's in the minimal set of FD's for the relation 'IPO' is { IPO_Name , Open_Date }, 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 left side 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.**