Boyce-Codd Normal Form Proof

1. Trader Relation

- **Attributes:**

  Trader(Login_ID, Profile_Picture, Address, PAN_No, Mobile_No, Type, Wallet_Amount, Demat_Account_No)

- **Functional Dependencies:**

  Login_ID → Pan_No.
  Login_ID → Profile_Picture
  Login_ID → Address
  Login_ID → Mobile_No.
  Login_ID → Type
  Login_ID → Wallet_Amount
  Login_ID → Demat_Account_No.

  Pan_No. → Login_ID
  Pan_No. → Profile_Picture
  Pan_No. → Address
  Pan_No. → Mobile_No.
  Pan_No. → Type
  Pan_No. → Wallet_Amount
  Pan_No. → Demat_Account_No.

- **Computing the Attribute Closure:**

  Login_ID$^+$ → {Login_ID, Profile_Picture, Address, Pan_No, Mobile_No, Type, Wallet_Amount, Demat_Account_No}

Pan_No.$^{+}$ → {Pan_No., Login_ID, Profile_Picture, Address, Mobile_No, Type, Wallet_Amount, Demat_Account_No}

Here, **'Login_ID'** and **'Pan_No.'** infers all the attributes of the relation **'Trader'.**

Primary Keys: Login_ID, Pan_No.

All the FDs in the minimal set of FDs for the relation **'Trader'** are inferred only by either of the primary keys **'Login_ID'** or **'Pan_No.'** Therefore, the relation **'Trader'** is in BCNF.

2. IPO Relation

- **Attributes:**

  IPO(Company_Name, Stock_Exchange, Start_Date, End_Date, Listing_Date, Min_Investment, Max_Investment, Lot_Size)

- **Functional Dependencies:**

  {Company_Name, Stock_Exchange, Start_Date, End_Date} → Listing_Date

  {Company_Name, Stock_Exchange, Start_Date, End_Date} → Max_Investment

  {Company_Name, Stock_Exchange, Start_Date, End_Date} → Min_Investment

  {Company_Name, Stock_Exchange, Start_Date, End_Date} → Lot_Size

- **Computing the Attribute Closure:**

  {Company_Name, Stock_Exchange, Start_Date, End_Date}$^+$ → {Company_Name, Stock_Exchange, Start_Date, End_Date, Listing_Date, Min_Investment, Max_Investment, Lot_Size}

Here, **‘{Company_Name, Stock_Exchange, Start_Date, End_Date}’** together infers all the attributes of the relation **‘IPO’.**

Primary Key: {Company_Name, Stock_Exchange, Start_Date, End_Date}

All the FDs in the minimal set of FDs for the relation **‘IPO’** are inferred only by the primary key **‘{Company_Name, Stock_Exchange, Start_Date, End_Date}’**. Therefore, the relation **‘IPO’** is in BCNF.

3. Blogs Relation

- **Attributes:**

  Blogs(Blog_ID, Blog_Title, Description, Publish_Date, Publish_Time)

- **Functional Dependencies:**

  Blog_ID → Blog_Title
  Blog_ID → Description
  Blog_ID → Publish_Date
  Blog_ID → Publish_Time

- **Computing the Attribute Closure:**

  Blog_ID$^+$ → { Blog_ID, Blog_Title, Description, Publish_Date, Publish_Time}

Here, **‘Blog_ID’** infers all the attributes of the relation **‘Blogs’.**

Primary Key: Blog_ID

All the FDs in the minimal set of FDs for the relation **‘Blogs’** are inferred only by the primary key ‘**Blog_ID’**. Therefore, the relation **‘Blogs’** is in BCNF.

4. Company Relation

- **Attributes:**

  Company(Name, Sector, Revenue)

- **Functional Dependencies:**

  Name → Sector
  Name → Revenue

- **Computing the Attribute Closure:**

  Name$^+$ → {Name, Sector , Revenue}

Here, **‘Name’** infers all the attributes of the relation **‘Company’.**

Primary Key: Name

All the FDs in the minimal set of FDs for the relation **‘Company’** are inferred only by the primary key **‘Name’**. Therefore, the relation **‘Company’** is in BCNF.

5. Stocks Relation

- **Attributes:**

  Stock(Stock_Symbol, Stock_Exchange, Curr_Price, Total_Quantity, Company_Name)

- **Functional Dependencies:**

  {Stock_Symbol, Stock_Exchange} → Curr_price
  {Stock_Symbol, Stock_Exchange} → Total_Quantity
  {Stock_Symbol, Stock_Exchange} → Company_Name

- **Computing the Attribute Closure:**

  {Stock_Symbol, Stock_Exchange}$^+$ → { Stock_Symbol, Stock_Exchange, Curr_price, Total_Quantity, Company_Name}

Here, **‘{Stock_Symbol, Stock_Exchange}’** together infers all the attributes of the relation **‘Stocks’.**

Primary key: {Stock_Symbol, Stock_Exchange}

All the FDs in the minimal set of FDs for the relation **‘Stocks’** are inferred only by the primary key **‘{Stock_Symbol, Stock_Exchange}’**. Therefore, the relation **‘Stocks’** is in BCNF.

6. Transaction Relation

- **Attributes:**

  Transaction(Transaction_ID, Bank_Name, Bank_Account_No., Mode_Of_Transaction, Credit_OR_Debit, Amount, Transaction_Date, Transaction_Time, Status)

- **Functional Dependencies:**

  Transaction_ID → Bank_Name
  Transaction_ID → Bank_Account_No
  Transaction_ID → Mode_Of_Transaction
  Transaction_ID → Credit_Or_Debit
  Transaction_ID → Amount
  Transaction_ID → Transaction_Date
  Transaction_ID → Transaction_Time
  Transaction_ID → Status

- **Computing the Attribute Closure:**

  Transaction_ID$^+$ → {Transaction_ID, Bank_Name, Bank_Account_No., Mode_Of_Transaction, Credit_OR_Debit, Amount, Transaction_Date, Transaction_Time, Status}

Here, **‘Transaction_ID’** infers all the attributes of the relation **‘Transaction’.**

Primary key: Transaction_ID

All the FDs in the minimal set of FDs for the relation **‘Transaction’** are inferred only by the primary key **‘Transaction_ID’**. Therefore, the relation **‘Transaction’** is in BCNF.

7. Promoter Relation

- **Attributes:**

  Promoter(Company_Name, Promoter_Name)

  Primary key: {Company_Name, Promoter_Name}

Here, **‘{Company_Name, Promoter_Name}’** will together be a primary key. So, all the tuples of the relation **‘Promoter’** will be unique. Therefore, the relation **‘Promoter’** is in BCNF.

8. Stock Watchlist Relation

- **Attributes:**

  Stock Watchlist(Stock_Symbol, Stock_Exchange, Login_ID)

  Primary key: {Stock_Symbol, Stock_Exchange, Login_ID}

Here, **‘{Stock_Symbol, Stock_Exchange, Login_ID}’** will together be a primary key. So, all the tuples of the relation **‘Stock Watchlist’** will be unique. Therefore, the relation **‘Stock Watchlist’** is in BCNF.

9. Stock Order Relation

- **Attributes:**

  Stock Order(Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date, Threshold_Value, Quantity, Buy_OR_Sell, Status)

- **Functional Dependencies:**

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date} → Threshold_Value

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date} → Quantity

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date} → Buy_OR_Sell

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date} → Status

- **Computing the Attribute Closure:**

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date}$^+$ → {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date, Threshold_Value, Quantity, Buy_OR_Sell, Status}

Here, **'{Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date}'** together infers all the attributes of the relation **'Stock Order'.**

Primary key: {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date}

All the FDs in the minimal set of FDs for the relation **‘Stock Order’** are inferred only by the primary key **‘{Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date}’**. Therefore, the relation **‘Stock Order’** is in BCNF.

10. Owns Relation

- **Attributes:**

  Owns(Login_ID, Stock_Symbol, Stock_Exchange, Quantity)

- **Functional Dependencies:**

  {Login_ID, Stock_Symbol, Stock_Exchange} → Quantity

- **Computing the Attribute Closure:**

  {Login_ID, Stock_Symbol, Stock_Exchange}$^+$ → {Login_ID, Stock_Symbol, Stock_Exchange, Quantity}

Here, **‘{Login_ID, Stock_Symbol, Stock_Exchange}’** together infers all the attributes of the relation **‘Owns’.**

Primary key: {Login_ID, Stock_Symbol, Stock_Exchange}

All the FDs in the minimal set of FDs for the relation **‘Owns’** are inferred only by the primary key **‘{Login_ID, Stock_Symbol, Stock_Exchange}’**. Therefore, the relation **‘Owns’** is in BCNF.

11. Bank Account Relation

- **Attributes:**

  Bank Account(Login_ID, Bank_Name, Bank_Account_No., IFSC Code}

- **Functional Dependencies:**

  {Bank_Name, Bank_Account_No.}→ Login_ID
  {Bank_Name, Bank_Account_No.}→ IFSC Code

- **Computing the Attribute Closure:**

  {Bank_Name, Bank_Account_No.}$^+$ → {Transaction_ID, Bank_Name, Bank_Account_No., Mode_Of_Transaction, Credit_OR_Debit, Amount, Transaction_Date, Transaction_Time, Status}

Here, **'{Bank_Name, Bank_Account_No.}'** together infers all the attributes of the relation **'Bank Account'.**

Primary key: {Bank_Name, Bank_Account_No.}

All the FDs in the minimal set of FDs for the relation **'Bank Account'** are inferred only by the primary key **'{Bank_Name, Bank_Account_No.}'**. Therefore, the relation **'Bank Account'** is in BCNF.

12. Admin Relation

- **Attributes:**

  Admin(Login_ID)

  Here, the relation **‘Admin’** has only one attribute **‘Login_ID’** which itself is a primary key. Therefore, the relation **‘Admin’** is in BCNF.

13. Has Written Relation

- **Attributes:**

  Has Written(Login_ID, Blog_ID)

  Primary key: {Login_ID, Blog_ID}

Here, **‘{Login_ID, Blog_ID}’** will together be a primary key. So, all the tuples of the relation **‘Has Written’** will be unique. Therefore, the relation **‘Has Written’** is in BCNF.

14. User Relation

- **Attributes:**

  User(Login_ID, Name, Password, E-Mail)

- **Functional Dependencies:**

  Login_ID → Name
  Login_ID → Password
  Login_ID → E-Mail

- **Computing the Attribute Closure:**

  Login_ID$^+$ → {Login_ID, Name, Password, E-Mail}

Here, **‘Login_ID’** infers all the attributes of the relation **‘User’.**

Primary Keys: Login_ID

All the FDs in the minimal set of FDs for the relation **‘User’** are inferred only by the primary key **‘Login_ID’.** Therefore, the relation **‘User’** is in BCNF.

15. IPO Watchlist Relation

- **Attributes:**

  IPO Watchlist(Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date)

  Primary key: {Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date}

Here, **‘{Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date}’** will together be a primary key. So, all the tuples of the relation **‘IPO Watchlist’** will be unique. Therefore, the relation **‘IPO Watchlist’** is in BCNF.

16. <u>Bidded Relation</u>

- **Attributes:**

  Bidded(Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date, Bidded_Lots, Status)

- **Functional Dependencies:**

  {Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date} → Bidded_Lot
  {Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date} → Status

- **Computing the Attribute Closure:**

  {Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date}$^{+}$ → {Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date, Bidded_Lots, Status}

Here, **'{Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date}'** together infers all the attributes of the relation **'User'.**

Primary key: {Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date}

All the FDs in the minimal set of FDs for the relation **'Bidded'** are inferred only by the primary key **'{Login_ID, Company_Name, Stock_Exchange, Start_Date, End_Date}'.** Therefore, the relation **'Bidded'** is in BCNF.

17. Mutual Fund Relation

- **Attributes:**

  Mutual Fund(MF_Symbol, Stock_Exchange, MF_Name, Curr_Price, Total_Quantity)

- **Functional Dependencies:**

  {MF_Symbol, Stock_Exchange} → MF_Name
  {MF_Symbol, Stock_Exchange} → Curr_price
  {MF_Symbol, Stock_Exchange} → Total_Quantity

- **Computing the Attribute Closure:**

  {MF_Symbol, Stock_Exchange}$^+$ → {MF_Symbol, Stock_Exchange, MF_Name, Curr_price, Total_Quantity}

Here, **'{MF_Symbol, Stock_Exchange}'** together infers all the attributes of the relation **'Mutual Fund'.**

Primary key: {MF_Symbol, Stock_Exchange}

All the FDs in the minimal set of FDs for the relation **'Mutual Fund'** are inferred only by the primary key **'{MF_Symbol, Stock_Exchange}'**. Therefore, the relation **'Mutual Fund'** is in BCNF.

18. Mutual Fund Invest Relation

- **Attributes:**

  Mutual Fund Invest(Login_ID, MF_Symbol, Stock_Exchange, Quantity)

- **Functional Dependencies:**

  {Login_ID, MF_Symbol, Stock_Exchange} → Quantity

- **Computing the Attribute Closure:**

  {Login_ID, MF_Symbol, Stock_Exchange}$^+$ → {Login_ID, MF_Symbol, Stock_Exchange, Quantity}

Here, **‘{Login_ID, MF_Symbol, Stock_Exchange}’** together infers all the attributes of the relation **‘Mutual Fund Invest’.**

Primary key: {Login_ID, MF_Symbol, Stock_Exchange}

All the FDs in the minimal set of FDs for the relation **‘Mutual Fund Invest’** are inferred only by the primary key **‘{Login_ID, MF_Symbol, Stock_Exchange}’**. Therefore, the relation **‘Mutual Fund Invest’** is in BCNF.

19. <u>Mutual Fund Watchlist Relation</u>

- **Attributes:**

  Mutual Fund Watchlist(MF_Symbol, Stock_Exchange, Login_ID)

  Primary key: {MF_Symbol, Stock_Exchange, Login_ID}

Here, **‘{MF_Symbol, Stock_Exchange, Login_ID}’** will together be a primary key. So, all the tuples of the relation **‘Mutual Fund Watchlist’** will be unique. Therefore, the relation **‘Mutual Fund Watchlist’** is in BCNF.

20. Mutual Fund Orders Relation

- **Attributes:**

  Mutual Fund Orders(MF_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time, Threshold_Value, Quantity, Buy_OR_Sell, Status)

- **Functional Dependencies:**

  {MF_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time} → Threshold_Value

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time} → Quantity

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time} → Buy_OR_Sell

  {Stock_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time} → Status

- **Computing the Attribute Closure:**

  {MF_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date}$^+$ → {MF_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time, Threshold_Value, Quantity, Buy_OR_Sell, Status}

Here, **'{MF_Symbol, Stock_Exchange, Login_ID, Purchase_Time, Purchase_Date}'** together infers all the attributes of the relation **'Mutual Fund Orders'.**

Primary key: {MF_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time}

All the FDs in the minimal set of FDs for the relation **‘Mutual Fund Orders’** are inferred only by the primary key **‘{MF_Symbol, Stock_Exchange, Login_ID, Purchase_Date, Purchase_Time}’**. Therefore, the relation **‘Mutual Fund Orders’** is in BCNF.

21. Collection Relation

- **Attributes:**

  Collection(MF_Symbol, MF_StockExchange, Stock_Symbol, Stock_StockExchange, Duration, Quantity)

- **Functional Dependencies:**

  {MF_Symbol, MF_StockExchange, Stock_Symbol, Stock_StockExchange, Duration} → Quantity

- **Computing the Attribute Closure:**

  {MF_Symbol, MF_StockExchange, Stock_Symbol, Stock_StockExchange, Duration}$^+$ → {MF_Symbol, MF_StockExchange, Stock_Symbol, Stock_StockExchange, Duration, Quantity}

Here, **‘{MF_Symbol, MF_StockExchange, Stock_Symbol, Stock_StockExchange, Duration}’** together infers all the attributes of the relation **‘Collection’.**

Primary key:{MF_Symbol, MF_StockExchange, Stock_Symbol, Stock_StockExchange, Duration}

All the FDs in the minimal set of FDs for the relation **‘Collection’** are inferred only by the primary key **‘{MF_Symbol, MF_StockExchange, Stock_Symbol, Stock_StockExchange, Duration}’**. Therefore, the relation **‘Collection’** is in BCNF.