





Minimal FD set and BCNF proof

To prove BCNF (Boyce-Codd Normal Form), we need to check that each table satisfies the following condition:

For every functional dependency $X \rightarrow Y$, X must be a superkey of the table.

Let's check each table one by one:

(1) Playlist Table ::

- $\text{Playlist_Id} \rightarrow \text{Last_Modify_time}$
- $\text{Playlist_Id} \rightarrow \text{Is_Collaborative}$
- $\text{Playlist_Id} \rightarrow \text{Access_Status}$
- $\text{Playlist_Id} \rightarrow \text{Playlist_Name}$
- $\text{Playlist_Id} \rightarrow \text{Creation_Date}$
- $\text{Playlist_Id} \rightarrow \text{Creator_Id}$

So Now , $\{\text{Playlist_Id}\}^+ =$

$\{\text{Playlist_Id}, \text{Last_Modify_time}, \text{Is_Collaborative}, \text{Access_Status}, \text{Playlist_Name}, \text{Creator_Id}, \text{Creation_Date}\}$

Therefore Key = Playlist_Id

Hence it is in BCNF Normal Form .

(2) Account Table ::

- $\text{Account_Id} \rightarrow \text{Account_Status}$
- $\text{Account_Id} \rightarrow \text{Password}$
- $\text{Account_Id} \rightarrow \text{Creator_Id}$
- $\text{Account_Id} \rightarrow \text{Registration_Date}$

So Now , $\{\text{Account_Id}\}^+ =$

$\{\text{Account_Id}, \text{Account_Status}, \text{Password}, \text{Creator_Id}, \text{Registration_Date}\}$

Therefore Key = Account_Id

Hence it is in BCNF Normal Form .

(3) Usr Table ::

- User_Id -> Pincode
- User_Id -> Address
- User_Id -> DOB
- User_Id -> Email
- User_Id -> Gender
- User_Id -> Name

So Now , {User_Id}⁺ =

{User_Id,Pincode,Address,DOB,Email,Gender,Name}

Therefore Key = User_Id

Hence it is in BCNF Normal Form .

(4) Subscription Table ::

- Subscription_Id -> Amount
- Subscription_Id -> Type
- Subscription_Id -> Time_period

So Now , {Subscription_Id}⁺ =

{Subscription_Id,Amount,Type,Time_Period}

Therefore Key = Subscription_Id

Hence it is in BCNF Normal Form .

(5) Payment Table ::

- Transaction_Id -> Method
- Transaction_Id -> Date
- Transaction_Id -> Time
- Transaction_Id -> Payment_Status
- Transaction_Id -> Amount
- Transaction_Id -> Payer_Id
- Transaction_Id -> Subscription_Id

So Now , {Transaction_Id}⁺ =

{Transaction_Id,Method,Date,Time,Payment_Status,Amount,
,Subscription_Id,Payer_Id}

Therefore Key = Transaction_Id

Hence it is in BCNF Normal Form .

(6) Album Table ::

- Album_Id -> Title
- Album_Id -> Duration
- Album_Id -> Release_Date

So Now , {Album_Id}⁺ =
 {Album_Id, Title, Duration, Release_Date}
 Therefore Key = Album_Id
 Hence it is in BCNF Normal Form .

(7) AudioBook Table ::

- AudioBook_Id -> Language
- AudioBook_Id -> Title
- AudioBook_Id -> Duration
- AudioBook_Id -> Author_Name
- AudioBook_Id -> Release_Date
- AudioBook_Id -> Chapter_No
- AudioBook_Id -> Parent_ID

So Now , {AudioBook_Id}⁺ =
 {AudioBook_Id, Language, Title, Duration, Author_Name, Release_Date, Chapter_No, Parent_ID}
 Therefore Key = AudioBook_Id
 Hence it is in BCNF Normal Form .

(8) Song Table ::

- Song_Id -> Duration
- Song_Id -> Language
- Song_Id -> Song_Name
- Song_Id -> Release_Date
- Song_Id -> Album_Id
- Song_Id -> Version_No
- Song_Id -> Parent_Id

So Now , {Song_ID}⁺ =
 {Song_Id, Duration, Language, Song_Name, Release_Date, Album_Id, Version_No, Parent_Id}
 Therefore Key = Song_Id
 Hence it is in BCNF Normal Form .

(9) Podcast Table ::

- Podcast_Id -> Duration
- Podcast_Id -> Language
- Podcast_Id -> Podcast_Name
- Podcast_Id -> Guest
- Podcast_Id -> Release_Date
- Podcast_Id -> Episode_No
- Podcast_Id -> Parent_Id

So Now , {Podcast_Id}⁺ =

{Podcast_Id,Duration,Language,Podcast_Name,Guest,Release_Date,Episode_No,Parent_Id}

Therefore Key = Podcast_Id

Hence it is in BCNF Normal Form .

(10) Artist Table ::

- Artist_Id -> Profession
- Artist_Id -> Artist_Name
- Artist_Id -> Country

So Now , {Artist_Id}⁺ =

{Artist_Id,Profession,Artist_Name,Country}

Therefore Key = Artist_Id

Hence it is in BCNF Normal Form .

(11) Ads Table ::

- Ad_Id -> Title
- Ad_Id -> Budget
- Ad_Id -> Duration
- Ad_Id -> Advertiser

So Now , {Ad_Id}⁺ =

{Ad_Id,Title,Budget,Duration,Advertiser}

Therefore Key = Ad_Id

Hence it is in BCNF Normal Form .

(12) Audio_Genre Table ::

- {Audiobook_Id,Type} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(13) Song_Genre Table ::

- {Song_Id,Type} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(14) Podcast_Genre Table ::

- {Podcast_Id,Type} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(15) Language_Pref Table ::

- {User_id , Language } => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key,

hence it is in a BCNF Normal Form.

(16) Genre_Pref Table ::

- {User_Id,type} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation .

Therefore both attributes together Form a candidate key,

hence it is in a BCNF Normal Form.

(17) Artist_Language ::

- {Artist_Id,Language} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation .

Therefore both attributes together Form a candidate key,

hence it is in a BCNF Normal Form.

(18) Follows Table ::

- {User_Id,Follower_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore

both attributes together Form a candidate key,

hence it is in a BCNF Normal Form.

(19) Modification_Access Table ::

- {User_Id ,Playlist_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key,
hence it is in a BCNF Normal Form.

(20) Used_By Table ::

- {Account_Id, User_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key,
hence it is in a BCNF Normal Form.

(21) Under Table ::

- {Subscription_Id, Account_Id} -> Start_Date
- {Subscription_Id, Account_Id} -> End_Date

So Now {Subscription_Id, Account_Id}+ =
{Subscription_Id, Account_Id, Start_Date, End_Date}
Therefore Key is {Subscription_Id, Account_Id}
Hence it is in BCNF Normal Form .

(22) Ads_in_Song Table ::

- {Song_Id, Ad_Id} -> Start_Date
- {Song_Id, Ad_Id} -> End_Date

So Now {Song_Id, Ad_Id}+ =
{Song_Id, Ad_Id, Start_Date, End_Date}
Therefore Key is {Song_Id, Ad_Id}
Hence it is in BCNF Normal Form .

(23) Ads_in_Podcast Table ::

- {Podcast_Id,Ad_Id} -> Start_Date
- {Podcast_Id,Ad_Id} -> End_Date

So Now {Podcast_Id,Ad_Id}⁺ =
 {Podcast_Id,Ad_Id,Start_Date,End_Date}
 Therefore Key is {Podcast_Id,Ad_Id}
 Hence it is in BCNF Normal Form .

(24) Ads_in_AudioBook Table ::

- {AudioBook_Id,Ad_Id} -> Start_Date
- {AudioBook_Id,Ad_Id} -> End_Date

So Now {AudioBook_Id,Ad_Id}⁺ =
 {AudioBook_Id,Ad_Id,Start_Date,End_Date}
 Therefore Key is {AudioBook_Id,Ad_Id}
 Hence it is in BCNF Normal Form .

(25) Narrated_By Table ::

- {Artist_Id,AudioBook_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(26) Sung_By Table ::

- {Artist_Id,Song_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(27) Hosted_By Table ::

- {Artist_Id,Podcast_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(28) Released_By Table ::

- {Artist_Id,Album_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(29) Contains Table ::

- {Playlist_Id,Song_Id} => Both Combined is a Key

There are only two attributes in the relation and none of them is functionally dependent on other. And there is no projected FD for this relation . Therefore both attributes together Form a candidate key, hence it is in a BCNF Normal Form.

(30) Album_Interaction Table ::

- {Album_Id,User_Id} -> User_rating
- {Album_Id,User_Id} -> Is_Favourite
- {Album_Id,User_Id} -> Is_Downloaded

So Now , {Album_Id,User_Id}+ = {Album_Id,User_Id,User_rating,Is_Favourite,Is_Downloaded}

Therefore Key is : {Album_Id,User_Id}

Hence it is in BCNF Normal Form .

(31) AudioBook_Rating Table ::

- {AudioBook_Id,User_Id} -> User_rating

So Now , {AudioBook_Id,User_Id}+ =

{AudioBook_Id,User_Id,User_Rating}

Therefore Key Is : {AudioBook_Id,User_Id}

Hence it is in BCNF Normal Form .

(32) AudioBook_Interaction Table ::

- {AudioBook_Id,User_Id} -> Is_Downloaded
- {AudioBook_Id,User_Id} -> Is_Favourite
- {AudioBook_Id,User_Id} -> Like_Status
- {AudioBook_Id,User_Id} -> PPlay_Count
- {AudioBook_Id,User_Id} -> Share_Count

So Now {AudioBook_Id,User_Id}+ =

{AudioBook_Id,User_Id,Is_Downloaded,Is_Favourite,Like_Status,PPlay_Count,Share_Count}

Therefore Key is : {AudioBook_Id,User_Id}

Hence it is in BCNF Normal Form .

(33) AudioBook_Comment Table ::

- {AudioBook_Id,User_Id} -> User_Comment

So Now , {AudioBook_Id,User_Id}+ =

{AudioBook_Id,User_Id,User_Comment}

Therefore Key is : {AudioBook_Id,User_Id}

Hence it is in BCNF Normal Form .

(34) Song_Rating Table ::

- {Song_Id,User_Id} -> User_rating

So Now , {Song_Id,User_Id}+ =
{Song_Id,User_Id,User_Rating}
Therefore Key Is : {Song_Id,User_Id}
Hence it is in BCNF Normal Form .

(35) Song_Interaction Table ::

- {Song_Id,User_Id} -> Is_Downloaded
- {Song_Id,User_Id} -> Is_Favourite
- {Song_Id,User_Id} -> Like_Status
- {Song_Id,User_Id} -> Play_Count
- {Song_Id,User_Id} -> Share_Count

So Now {Song_Id,User_Id}+ =
{Song_Id,User_Id,Is_Downloaded,Is_Favourite,Like_Status,Play_Count,Share_Count}
Therefore Key is : {Song_Id,User_Id}
Hence it is in BCNF Normal Form .

(36) Song_Comment Table ::

- {Song_Id,User_Id} -> User_Comment

So Now , {Song_Id,User_Id}+ =
{Song_Id,User_Id,User_Comment}
Therefore Key is : {Song_Id,User_Id}
Hence it is in BCNF Normal Form .

(37) Podcast_Rating Table ::

- {Podcast_Id,User_Id} -> User_rating

So Now , {Podcast_Id,User_Id}+ =
{Podcast_Id,User_Id,User_Rating}
Therefore Key Is : {Podcast_Id,User_Id}
Hence it is in BCNF Normal Form .

(38) Podcast_Interaction Table ::

- {Podcast_Id,User_Id} -> Is_Downloaded

- {Podcast_Id,User_Id} -> Is_Favourite
- {Podcast_Id,User_Id} -> Like_Status
- {Podcast_Id,User_Id} -> PPlay_Count
- {Podcast_Id,User_Id} -> Share_Count

So Now {Podcast_Id,User_Id}⁺ =
 {Podcast_Id,User_Id,Is_Downloaded,Is_Favourite,Like_Status,PPlay_Count,Share_Count}
 Therefore Key is : {Podcast_Id,User_Id}
 Hence it is in BCNF Normal Form .

(39) Podcast_Comment Table ::

- {Podcast_Id,User_Id} -> User_Comment

So Now , {Podcast_Id,User_Id}⁺ =
 {Podcast_Id,User_Id,User_Comment}
 Therefore Key is : {Podcast_Id,User_Id}
 Hence it is in BCNF Normal Form .

(40) Artist_Interaction Table ::

- {Artist_Id_Id,User_Id} -> Is_Favourite
- {Artist_Id_Id,User_Id} -> Is_Following

So Now {Artist_Id_Id,User_Id}⁺ =
 {Artist_Id_Id,User_Id,Is_Favourite,Is_Following}
 Therefore Key is : {Artist_Id_Id,User_Id}
 Hence it is in BCNF Normal Form .

●●● CONCLUSION ●●●●

From above proof , all the tables in the database are in BCNF Normal Form . We have written the minimal FD set and closure of all the FDs .