





Team 12

OTT Platform DBMS- "Framefluence"

Normalization Proofs

1.) Users Relation:

Attributes: { User_ID, User_name, d_o_b, email, nationality }

Primary Key: User_ID

Minimal Set of Functional Dependencies:

User_ID \rightarrow User_name

User_ID \rightarrow d_o_b

User_ID \rightarrow email

User_ID \rightarrow nationality

Closure of Primary Key (User_ID⁺):

Let X = User_ID

X⁺ = { User_ID, User_name, d_o_b, email, nationality }

The closure of User_ID includes all attributes of the User relation, meaning the primary key is User_ID. Since the left side of all functional dependencies in the minimal set has User_ID (which is the primary key), the User table is in BCNF.

2.) Subscription Relation:

Attributes: { Subs_ID, Subscription Plan, Amount, Duration }

Primary Key: Subs_ID

Minimal Set of Functional Dependencies:

Subs_ID \rightarrow Subscription Plan

Subs_ID \rightarrow Amount

Subs_ID \rightarrow Duration

Closure of Primary Key (Subs_ID⁺):

Let X = Subs_ID

$X^+ = \{ \text{Subs_ID, Subscription Plan, Amount, Duration} \}$

The closure of Subs_ID includes all attributes of the Subscription relation, meaning the primary key is Subs_ID. Since the left side of all functional dependencies in the minimal set has Subs_ID (which is the primary key), the Subscription table is in BCNF.

3.) Payment Relation:

Attributes: { Payment_ID, Payment Method, Amount_Paid, Date of pay }

Primary Key: Payment_ID

Minimal Set of Functional Dependencies:

Payment_ID → Payment Method

Payment_ID → Amount_Paid

Payment_ID → Date of pay

Closure of Primary Key (Payment_ID⁺):

Let X = Payment_ID

$X^+ = \{ \text{Payment_ID, Payment Method, Amount_Paid, Date of pay} \}$

The closure of Payment_ID includes all attributes of the Payment relation, meaning the primary key is Payment_ID. Since the left side of all functional dependencies in the minimal set has Payment_ID (which is the primary key), the Payment table is in BCNF.

4.) User-Subscribed_Payment Relation:

Attributes: { User_ID, Sub_ID, Pay_ID, Renewal Date }

Primary Key: { User_ID, Sub_ID, Pay_ID } (composite key)

Minimal Set of Functional Dependencies:

{ User_ID, Sub_ID, Pay_ID } → Renewal Date

Closure of Primary Key (User_ID, Sub_ID, Pay_ID)⁺:

Let X = { User_ID, Sub_ID, Pay_ID }

$X^+ = \{ \text{User_ID}, \text{Sub_ID}, \text{Pay_ID}, \text{Renewal Date} \}$

The closure of $\{ \text{User_ID}, \text{Sub_ID}, \text{Pay_ID} \}$ includes all attributes of the User-Subscribed_Payment relation, meaning the primary key is $\{ \text{User_ID}, \text{Sub_ID}, \text{Pay_ID} \}$. Since the left side of all functional dependencies in the minimal set has $\{ \text{User_ID}, \text{Sub_ID}, \text{Pay_ID} \}$ (which is the primary key), the User-Subscribed_Payment table is in BCNF.

5.) User_Device Relation:

Attributes: $\{ \text{User_ID}, \text{Device_ID}, \text{Device Type} \}$

Primary Key: $\{ \text{User_ID}, \text{Device_ID} \}$ (composite key)

Minimal Set of Functional Dependencies:

$\{ \text{User_ID}, \text{Device_ID} \} \rightarrow \text{Device Type}$

Closure of Primary Key $(\text{User_ID}, \text{Device_ID})^+$:

Let $X = \{ \text{User_ID}, \text{Device_ID} \}$

$X^+ = \{ \text{User_ID}, \text{Device_ID}, \text{Device Type} \}$

The closure of $\{ \text{User_ID}, \text{Device_ID} \}$ includes all attributes of the User_Device relation, meaning the primary key is $\{ \text{User_ID}, \text{Device_ID} \}$. Since the left side of all functional dependencies in the minimal set has $\{ \text{User_ID}, \text{Device_ID} \}$ (which is the primary key), the User_Device table is in BCNF.

6.) Playlist Relation:

Attributes: $\{ \text{Playlist_ID}, \text{Playlist_type}, \text{Last_updated}, \text{Creation_date} \}$

Primary Key: Playlist_ID

Minimal Set of Functional Dependencies:

$\text{Playlist_ID} \rightarrow \text{Playlist_type}$

$\text{Playlist_ID} \rightarrow \text{Last_updated}$

$\text{Playlist_ID} \rightarrow \text{Creation_date}$

Closure of Primary Key $(\text{Playlist_ID})^+$:

Let $X = \text{Playlist_ID}$

$X^+ = \{ \text{Playlist_ID}, \text{Playlist_type}, \text{Last_updated}, \text{Creation_date} \}$

The closure of Playlist_ID includes all attributes of the Playlist relation, meaning the primary key is Playlist_ID. Since the left side of all functional dependencies in the minimal set has Playlist_ID (which is the primary key), the Playlist table is in BCNF.

7.) Content Relation:

Attributes: { Content_ID, Title, Release Date, Access Type, Age_rating, Origin country }

Primary Key: Content_ID

Minimal Set of Functional Dependencies:

Content_ID \rightarrow Title

Content_ID \rightarrow Release Date

Content_ID \rightarrow Access Type

Content_ID \rightarrow Age_rating

Content_ID \rightarrow Origin country

Closure of Primary Key (Content_ID⁺):

Let X = Content_ID

X⁺ = { Content_ID, Title, Release Date, Access Type, Age_rating, Origin country }

The closure of Content_ID includes all attributes of the Content relation, meaning the primary key is Content_ID. Since the left side of all functional dependencies in the minimal set has Content_ID (which is the primary key), the Content table is in BCNF.

8.) Metrics Relation:

Attributes: { Content_id, Total_revenue, Total_Views, Budget }

Primary Key: Content_id

Minimal Set of Functional Dependencies:

Content_id \rightarrow Total_revenue

Content_id \rightarrow Total_Views

Content_id \rightarrow Budget

Closure of Primary Key (Content_id⁺):

Let X = Content_id

X⁺={Content_id, Total_revenue, Total_Views, Budget}

The closure of Content_id includes all attributes of the Metrics relation, meaning the primary key is Content_id. Since the left side of all functional dependencies in the minimal set has Content_id (which is the primary key), the Metrics table is in BCNF.

9.) Watch History Relation:

Attributes: { User_ID, Content-ID, Duration, Watch_date }

Primary Key: { User_ID, Content-ID }

Minimal Set of Functional Dependencies:

{ User_ID, Content-ID } \rightarrow Duration

{ User_ID, Content-ID } \rightarrow Watch_date

Closure of Primary Key (User_ID, Content-ID):

Let $X = \{ \text{User_ID, Content_ID} \}$

$X^+ = \{ \text{User_ID, Content_ID, Duration, Watch_date} \}$

The closure of the composite key { User_ID, Content-ID } includes all attributes of the Watch History relation, meaning the primary key is { User_ID, Content-ID }. Since the left side of all functional dependencies in the minimal set has the composite key { User_ID, Content-ID } (which is the primary key), the Watch History table is in BCNF.

10.) Content_Genre Relation:

Attributes: { Content_ID, Genre }

Primary Key: { Content_ID, Genre }

Minimal Set of Functional Dependencies:

{ Content_ID, Genre } \rightarrow {Content_ID, Genre}

Closure of Primary Key (Content_ID, Genre*):

Let $X = \{ \text{Content_ID, Genre} \}$

$X^+ = \{ \text{Content_ID, Genre} \}$

$X^+ = \{\text{Content_ID}, \text{Genre}\}$

The closure of the composite key $\{\text{Content_ID}, \text{Genre}\}$ includes all attributes of the Content_Genre relation, meaning the primary key is $\{\text{Content_ID}, \text{Genre}\}$. Since there are no partial dependencies (no attribute depends only on part of the composite key), the Content_Genre table is in BCNF.

11.) Playlist_Content Relation:

Attributes: $\{\text{Playlist_ID}, \text{Content_ID}\}$

Primary Key: $\{\text{Playlist_ID}, \text{Content_ID}\}$

Minimal Set of Functional Dependencies:

$\{\text{Playlist_ID}, \text{Content_ID}\} \rightarrow \{\text{Playlist_ID}, \text{Content_ID}\}$

Closure of Primary Key ($\text{Playlist_ID}, \text{Content_ID}^+$):

$X^+ = \{\text{Playlist_ID}, \text{Content_ID}\}$

The closure of the composite key $\{\text{Playlist_ID}, \text{Content_ID}\}$ includes all attributes of the Playlist_Content relation, meaning the primary key is $\{\text{Playlist_ID}, \text{Content_ID}\}$. Since there are no partial dependencies (no attribute depends only on part of the composite key), the Playlist_Content table is in BCNF.

12.) Content_Artist Relation:

Attributes: $\{\text{Content_id}, \text{Artist_id}\}$

Primary Key: $\{\text{Content_id}, \text{Artist_id}\}$

Minimal Set of Functional Dependencies:

$\{\text{Content_id}, \text{Artist_id}\} \rightarrow \{\text{Content_id}, \text{Artist_id}\}$

Closure of Primary Key ($\text{Content_id}, \text{Artist_id}^+$):

Let $X = \{\text{Content_id}, \text{Artist_id}\}$

$X^+ = \{\text{Content_id}, \text{Artist_id}\}$

The closure of the composite key $\{\text{Content_id}, \text{Artist_id}\}$ includes all attributes of the Content_Artist relation, meaning the primary key is $\{\text{Content_id}, \text{Artist_id}\}$. Since there are no partial dependencies (no attribute depends only on part of the composite key), the Content_Artist table is in BCNF.

13.) Content_Language Relation:

Attributes: $\{\text{Content_ID}, \text{Language}\}$

Primary Key: $\{\text{Content_ID}, \text{Language}\}$

Minimal Set of Functional Dependencies:

$\{\text{Content_ID}, \text{Language}\} \rightarrow \{\text{Content_ID}, \text{Language}\}$

Closure of Primary Key ($\text{Content_ID}, \text{Language}^+$):

Let $X^+ = \{\text{Content_ID}, \text{Language}\}$

The closure of the composite key $\{\text{Content_ID}, \text{Language}\}$ includes all attributes of the Content_Language relation, meaning the primary key is $\{\text{Content_ID}, \text{Language}\}$. Since there are no partial dependencies (no attribute depends only on part of the composite key), the Content_Language table is in BCNF.

14.) Artist Relation:

Attributes: $\{\text{Artist_id}, \text{Role_played}, \text{Artist_Name}\}$

Primary Key: Artist_id

Minimal Set of Functional Dependencies:

$\text{Artist_id} \rightarrow \text{Role_played}$

$\text{Artist_id} \rightarrow \text{Artist_Name}$

Closure of Primary Key (Artist_id^+):

Let $X^+ = \{\text{Artist_id}, \text{Role_played}, \text{Artist_Name}\}$

The closure of Artist_id includes all attributes of the Artist relation, meaning the primary key is Artist_id. Since the left side of all functional dependencies in the minimal set has Artist_id (which is the primary key), the Artist table is in BCNF.

15.) Actor Relation:

Attributes: { Artist_id, Actor_name, Gender, DOB, Nationality }

Primary Key: Artist_id

Minimal Set of Functional Dependencies:

Artist_id \rightarrow Actor_name

Artist_id \rightarrow Gender

Artist_id \rightarrow DOB

Artist_id \rightarrow Nationality

Closure of Primary Key (Artist_id⁺):

Let

$X^+ = \{\text{Artist_id}, \text{Actor_name}, \text{Gender}, \text{DOB}, \text{Nationality}\}$

The closure of Artist_id includes all attributes of the Actor relation, meaning the primary key is Artist_id. Since the left side of all functional dependencies in the minimal set has Artist_id (which is the primary key), the Actor table is in BCNF.

16.) Non_Actor Relation:

Attributes: { Artist_id, Job, Gender, DOB, Nationality } Primary Key: Artist_id Minimal Set of Functional Dependencies:

Artist_id \rightarrow Job

Artist_id \rightarrow Gender

Artist_id \rightarrow DOB

Artist_id \rightarrow Nationality

Closure of Primary Key (Artist_id⁺):

$X^+ = \{\text{Artist_id, Job, Gender, DOB, Nationality}\}$

The closure of Artist_id includes all attributes of the Non_Actor relation, meaning the primary key is Artist_id. Since the left side of all functional dependencies in the minimal set has Artist_id (which is the primary key), the Non_Actor table is in BCNF.

17.) Movies Relation:

Attributes: { Content_Id, Duration }

Primary Key: Content_Id

Minimal Set of Functional Dependencies:

$\text{Content_Id} \rightarrow \text{Duration}$

Closure of Primary Key (Content_Id⁺): $= \{\text{Content_Id, Duration}\}$

The closure of Content_Id includes all attributes of the Movies relation, meaning the primary key is Content_Id. Since the left side of the functional dependency in the minimal set has Content_Id (which is the primary key), the Movies table is in BCNF.

18.) Series Relation:

Attributes: { Content_ID, Duration }

Primary Key: Content_ID

Minimal Set of Functional Dependencies:

$\text{Content_ID} \rightarrow \text{Duration}$

Closure of Primary Key (Content_ID⁺):

$X^+ = \{\text{Content_ID, Duration}\}$

The closure of Content_ID includes all attributes of the Series relation, meaning the primary key is Content_ID. Since the left side of the functional dependency in the minimal set has Content_ID (which is the primary key), the Series table is in BCNF.

19.) Episodes Relation:

Attributes: { Episode_No, Season_No, Content_ID, EP_Title, Description }

Primary Key: { Episode_No, Season_No, Content_ID }

Minimal Set of Functional Dependencies:

$\{ \text{Episode_No}, \text{Season_No}, \text{Content_ID} \} \rightarrow \text{EP_Title}$

$\{ \text{Episode_No}, \text{Season_No}, \text{Content_ID} \} \rightarrow \text{Description}$

Closure of Primary Key (Episode_No, Season_No, Content_ID*):

Let $X = \{ \text{Episode_No}, \text{Season_No}, \text{Content_ID} \}$

$X^+ = \{ \text{Episode_No}, \text{Season_No}, \text{Content_ID}, \text{EP_Title}, \text{Description} \}$

The closure of the composite key $\{ \text{Episode_No}, \text{Season_No}, \text{Content_ID} \}$ includes all attributes of the Episodes relation, meaning the primary key is $\{ \text{Episode_No}, \text{Season_No}, \text{Content_ID} \}$. Since the left side of all functional dependencies in the minimal set has the composite key $\{ \text{Episode_No}, \text{Season_No}, \text{Content_ID} \}$ (which is the primary key), the Episodes table is in BCNF.

20.) Ratings Relation:

Attributes: $\{ \text{User_ID}, \text{Content_ID}, \text{Ratings} \}$

Primary Key: $\{ \text{User_ID}, \text{Content_ID} \}$

Minimal Set of Functional Dependencies:

$\{ \text{User_ID}, \text{Content_ID} \} \rightarrow \text{Ratings}$

Closure of Primary Key (User_ID, Content_ID*):

$X^+ = \{ \text{User_ID}, \text{Content_ID}, \text{Ratings} \}$

The closure of the composite key $\{ \text{User_ID}, \text{Content_ID} \}$ includes all attributes of the Ratings relation, meaning the primary key is $\{ \text{User_ID}, \text{Content_ID} \}$. Since there are no partial dependencies (no attribute depends only on part of the composite key), the Ratings table is in BCNF.