SSN COLLEGE OF ENGINEERING

AFFILIATED TO ANNA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UCS2404 - DATABASE MANAGEMENT SYSTEM

MINI PROJECT

TITLE - RAILWAY MANAGEMENT SYSTEM

PROJECT MEMBERS

3122215001037 – Jaanus Sri K G

3122215001039 – Tejaswi Kakarla

3122215001051 – Mega V

IDENTIFIED FUNCTIONAL DEPENDENCIES (FDs):

USER

User_ID ⟶ F_Name

User_ID ⟶ L_Name

User_ID ⟶ Age

User_ID ⟶ Gender

User_ID ⟶ Address

User_ID ⟶ Mobile_no

User_ID, Address ⟶ Mobile_no

TRAIN

Tr_no ⟶ Tr_name

Tr_no ⟶ Capacity

Tr_no ⟶ Source

Tr_no ⟶ Dest

Tr_no ⟶ S_Time

Tr_no ⟶ Dest_Time

Tr_no ⟶ St_no

St_no ⟶ St_name

St_no ⟶ Arr_Time

St_no ⟶ Dept_Time

TICKET

Ticket_ID ⟶ No_of_passengers

Ticket_ID ⟶ User_ID

Ticket_ID ⟶ PNR_No

{Tr_no, Ticket_ID} ⟶ PNR_No

Ticket_ID ⟶ Tr_no

Ticket_ID ⟶ Ticket_Status

{PNR_No, Tr_no} ⟶ Ticket_Status

Ticket_ID ⟶ Res_Date

Ticket_ID ⟶ Book_Date

PAYMENT

Payment_ID ⟶ Ticket_ID

Payment_ID ⟶ Amount

NORMALIZATION:

1NF:

Disallows composite attributes, multivalued attributes and nested relations (attributes whose values for an individual tuple are non-atomic)

2NF:

1) Prime attribute: An attribute that is member of the primary key K
2) Full functional dependency: a FD Y -> Z where removal of any attribute from Y means the FD does not hold any more
3) A relation schema R is in second normal form (2NF) if every non-prime attribute A in R is fully functionally dependent on the primary key

3NF:

1) Transitive functional dependency: a FD X -> Z that can be derived from two FDs X -> Y and Y -> Z
2) A relation schema R is in third normal form (3NF) if it is in 2NF and no non-prime attribute A in R is transitively dependent on the primary key

BCNF:

1) A relation schema R is in Boyce-Codd Normal Form (BCNF) if whenever an FD X -> A holds in R, then X is a super key of R

USER

User_ID	**F_Name**	**L_Name**	**Age**	**Gender**	**Address**	**Mobile_no**

User (User_ID, F_name, L_Name, Age, Gender, Address, Mobile_No)

R (A, B, C, D, E, F, G)

FD's = { A - > B , A -> C , A -> D , A-> E , A -> F , A -> G , AF - > G }

A -> BCDEFG

AF -> G

Minimal Set of FD'S :

To check whether A -> BCDEFG is need or not

Closure , $\{ A \}^+ = \{ A , B , C , D , E, F , G \}$

Ignore the FD A -> BCDEFG and Find the closure

$\{ A \}^+ = \{ A \}$

The FD A -> BCDEFG is needed

To check whether A F -> G is need or not

Closure , $\{ AF \}^+ = \{ A , F , B , C, D , E ,G \}$

Ignore the FD A F -> G and Find the closure

$\{ AF \}^+ = \{ A , F , B , C, D , E ,G \}$

FD: AF -> G is not needed

Minimal Set of FD's: { A -> BCDEFG }

FD'S = { User_ID -> F_Name , User_ID -> L_Name , User_ID -> Age , User_ID -> Gender , User_ID -> Address , User_ID -> Mobile_no }

To Find the Candidate Key

$\{ ABCDEFG \}^+ = \{ A , B, C, D, E, F, G \}$

Based on the Fds, we can remove the attributes from candidate key. If we remove then

$\{ A \}^+ = \{ A , B, C , D, E, F, G \}$

Here there is no proper subset for a closure. So $\{ A \}^+$ is a Candidate Key

Candidate Key CK { User_ID }

Prime Attributes PA { User_ID }

Non-Prime Attributes NPA { F_name, L_Name, Age, Gender, Address, Mobile_No}

1NF: The User table contains multivalued attribute (address).

So, we need to decompose the address into several attributes.

USER

User_ID	F_Name	L_Name	Age	Gender	City	State	Pin	Mobile_no

FDs for User Table { User_ID -> F_Name , User_ID -> L_Name , User_ID -> Age , User_ID -> Gender, User_ID -> Mobile_no , User_ID -> Pin , Pin -> { City ,State} }

2NF: We need to check if there is any FD where the non-prime attribute is not fully functional dependent or in other words we have to find if there are any partial dependencies

Here there is no proper subset for a candidate key.

Here, there are no partially dependencies which means fully dependencies exists. So User Relation satisfy the 2NF

3NF: To check transitive dependencies (NPA -> NPA) in the relation.

User_ID -> F_Name , User_ID -> L_Name , User_ID -> Age , User_ID -> Gender , User_ID -> Mobile_no , User_ID -> Pin , Pin -> { City ,State}

Prime Attributes PA { User_ID }

Non-Prime Attributes NPA {F_name, L_Name, Age, Gender, Address, Mobile_No , City , State , Pin}

We can observe that City and State attributes are derived from Pin which is Non-Prime attribute

So, here transitive dependencies exist. The User table does not satisfy the 3NF. So we divide the new User_Address table with the attributes City, State and Pin as a Primary Or Candidate Key

USER

User_ID	F_Name	L_Name	Age	Gender	Pin	Mobile_no

FD'S Set For USER Table { User_ID -> F_Name , User_ID -> L_Name , User_ID -> Age , User_ID -> Gender , User_ID -> Mobile_no , User_ID -> Pin }

USER_ADDRESS

Pin	City	State

FD'S Set For USER_ADDRESS Table : Pin -> { City ,State}

BCNF:

To check whether all the attributes are derived from the candidate Key or Super key

User_ID -> F_Name , User_ID -> L_Name , User_ID -> Age , User_ID -> Gender , User_ID -> Mobile_no User_ID -> Pin

We can observe that all the non-prime attributes are derived from the Super Key attribute(Super key exists in the left side of all the FD's)

So User table satisfy the BCNF

USER_ADDRESS

Pin	City	State

USER_ADDRESS (Pin, CITY, STATE)

USER_ADDRESS (A, B, C)

FD'S Set For User_Address Table {Pin -> {City, State}}

Candidate Key, CK { Pin }$^{+}$ = { Pin, City, State }

Prime Attributes PA {Pin}

Non-Prime Attributes NPA {City, State }

We can observe that all the non-prime attributes are derived from the Prime attribute.

So here no transitive dependencies exist. The USER_ADDRESS table satisfies the 3NF

BCNF:

To check whether all the attributes are derived from the candidate Key or Super key

Pin -> {City, State}

We can observe that all the non-prime attributes are derived from the Super Key attribute (Super key exists in the left side of all the FD's)

So USER_ADDRESS table satisfy the BCNF

TRAIN

Tr_no	Tr_Name	Cap	Source	Dest	S_Time	Dest_Time	St_no	St_Name	Arr_time	Dept_time

TRAIN (Tr_no , Tr_Name , Cap , Source , Dest , S_Time , Dest_Time , St_no ,St_Name , Arr_Time, Dept_Time)

TRAIN (A , B ,C , D , E , F , G , H , I , J , K)

FD's = { A - > B , A -> C , A -> D , A-> E , A -> F , A -> G , AE -> G , AD->F, AH -> I , AH -> J , AH -> K }

A -> BCDEFG

AE -> G

AD->F

AH -> IJK

Minimal Set of FD'S :

To check whether A -> BCDEFG is need or not

Closure , $\{ A \}^+ = \{ A , B , C , D , E, F , G \}$

Ignore the FD A -> BCDEFG and Find the closure

$\{ A \}^+ = \{ A \}$

FD: A -> BCDEFG is needed

To check whether AE -> G is need or not

Closure , $\{ AE \}^+ = \{ A , E , B , C , D , F , G \}$

Ignore the FD A F -> G and Find the closure

$\{ AF \}^+ = \{ A , E , B , C , D , F , G \}$

FD: AE -> G is not needed

To check whether AD->F is need or not

Closure , $\{ AD \}^+ = \{ A , D , B , C , E ,G , F \}$

Ignore the FD A F -> G and Find the closure

$\{ AD \}^+ = \{ A , D , B , C , E ,G , F \}$

FD: AD -> F is not needed

To check whether AH -> IJK is need or not

Closure , $\{ AH \}^+ = \{ A, B, C, D, E, F, G, H, I, J, K \}$

Ignore the FD AH -> IJK and Find the closure

$\{ AH \}^+ = \{ A, B, C, D, E, F, G, H\}$

The FD AH -> IJK is needed

Minimal Set of FD's : { A -> BCDEFG , H -> IJK }

FD'S = { Tr_no -> Tr_name , Tr_no -> name , Tr_no -> Cap , Tr_no ->Source , Tr_no -> Dest , Tr_no -> S_Time , Tr_no -> Dest_Time , {Tr_no, St_no }-> St_Name , {Tr_no, St_no }-> Arr_Time, {Tr_no, St_no }-> Dept_Time }

Find the Candidate Key for the Relation TRAIN

$\{ ABCDEFGHIJK \}^+ = \{ A , B, C, D ,E , F , G , H , I , J, K\}$

Based on the Fds, we can remove the attributes from candidate key. If we remove then

$\{ AH \}^+ = \{ A , H , B, C , D , E , F , G , I , J , K \}$

Here there is no proper subset for a closure. So $\{ A \}^+$ is a Candidate Key

Candidate Key CK { Tr_no , St_no }

Prime Attributes PA { Tr_no , St_no }

Non-Prime Attributes NPA { Tr_Name , Cap , Source , Dest , S_Time , Dest_Time ,St_Name , Arr_Time, Dept_Time }

1NF: The User table contains no multivalued attribute. So it satisfy the 1NF

2NF : We need to check if there is any FD where the non-prime attribute is not fully functional dependent or in other words we have to find if there are any partial dependencies

$\{ Tr\_no \}^+ = \{$ Tr_Name , Cap , Source , Dest , S_Time , Dest_Time $\}$

$\{ St\_no \}^+ = \{ \}$

Here there is one partially dependency that means fully dependencies exists. So TRAIN Relation does not satisfy 2NF. So we have to decompose the relation into two Relations

TRAIN (Tr_no , Tr_Name , Cap , Source , Dest , S_Time , Dest_Time)

FD'S = { Tr_no -> Tr_name , Tr_no -> name , Tr_no -> Cap , Tr_no ->Source , Tr_no -> Dest , Tr_no -> S_Time , Tr_no -> Dest_Time , }

Candidate Key CK = $\{ Tr\_no \}^+ = \{$ Tr_Name , Cap , Source , Dest , S_Time , Dest_Time$\}$

STATION (St_no , St_Name , Arr_Time , Dept_Time)

FD'S = { {Tr_no, St_no } -> St_Name , {Tr_no, St_no} -> Arr_Time, {Tr_no, St_no} -> Dept_Time }

Candidate Key CK = { Tr_no, St_no }$^{+}$ = { Tr_no, St_no, St_Name , Arr_Time , Dept_Time }

TRAIN

Tr_no	Tr_Name	Cap	Source	Dest	S_Time	Dest_Time

STATION

Tr_no	St_no	St_Name	Arr_Time	Dept_Time

3NF: To check transitive dependencies (NPA -> NPA) in the relation.

Tr_no -> Tr_name , Tr_no -> name , Tr_no -> Cap , Tr_no ->Source , Tr_no -> Dest , Tr_no -> S_Time , Tr_no -> Dest_Time ,

Prime Attributes PA { Tr_no }

Non-Prime Attributes NPA { Tr_name, Cap , Source , Dest , S_Time , Dest_Time }

We can observe that all the non-prime attributes are derived from Tr_no which is Prime attribute. So Here there is no transitivity dependencies. Therefore Relation TRAIN Follows the 3NF

BCNF:

Tr_no -> { Tr_name , Cap , Source , Dest , S_Time, Dest_Time }

To check whether all the attributes are derived from the candidate Key or Super key

We can observe that all the non-prime attributes are derived from the Super Key attribute(Super key exists in the left side of all the FD's)

So TRAIN relation satisfy the BCNF

STATION (Tr_no, St_no , St_Name , Arr_Time , Dept_Time)

STATION

Tr_no	St_no	St_Name	Arr_Time	Dept_Time

FD'S = { {Tr_no, St_no} -> St_Name, { Tr_no, St_no} -> Arr_Time, { Tr_no, St_no } -> Dept_Time }

Candidate Key CK = {Tr_no, St_no}$^{+}$ = { St_Name , Arr_Time , Dept_Time }

Prime Attributes PA {Tr_no, St_no}

Non-Prime Attributes NPA {St_Name, Arr_Time , Dept_Time }

2NF: We need to check if there is any FD where the non-prime attribute is not fully functional dependent or in other words we have to find if there are any partial dependencies

Here there is no proper subset for a candidate key.

Here there is no partially dependencies that means fully dependencies exists. So STATION Relation satisfy the 2NF

3NF: To check transitive dependencies (NPA -> NPA) in the relation.

{Tr_no, St_no} -> St_Name, {Tr_no, St_no} -> Arr_Time, {Tr_no, St_no} -> Dept_Time

We can observe that all the non-prime attributes are derived from St_no and Tr_no which is Prime attribute. So here, there are no transitivity dependencies. Therefore Relation STATION Follows the 3NF

BCNF:

To check whether all the attributes are derived from the candidate Key or Super key

We can observe that all the non-prime attributes are derived from the Super Key attribute(Super key exists in the left side of all the FD's)

So STATION relation satisfy the BCNF

TICKET

Tickte_ID	No_of_Passengers	User_ID	PNR_No	Tr_no	Ticket_status	Res_date	Book_date

TICKET (Ticket_ID , No_of_Passengers , User-ID , Tr_no , Ticket_Status , Res_date , Book_date)

TICKET (A , B ,C , D ,E , F, G ,H)

FD'S = { A -> B , A -> C , A -> D , A -> E , A -> F , A -> G ,A -> H , DG -> E , AH -> F}

A -> BCDEFG

DE -> F

AG -> F

Minimal Set of FD's:

To check whether A -> BCDEFG is need or not

Closure : $\{ A \}^+ = \{ A , B , C , D , E, F , G \}$

Ignore the FD A -> BCDEFG and Find the closure

$\{A\}^+ = \{A\}$

FD: A -> BCDEFG is needed

To check whether DE -> F is need or not

Closure : { DE }$^+$ = { D , E , F }

Ignore the FD: CD -> E and Find the closure

{DE}$^+$ = {D, E}

FD: DE -> F is needed

To check whether AH -> F is need or not

Closure , { AH }$^+$ = { A , H , F , B, C , D ,E,G }

Ignore the FD A D -> E and Find the closure

{AG}$^+$ = { A , H , F , B, C , D ,E,G }

FD: AH -> F is not needed

Minimal Set of FD's = {A -> BCDEFG, DE -> F}

FDs = { Ticket_ID -> No_Of_Passengers , Ticket_ID ->User_ID , Ticket_ID -> PNR_No , Ticket_ID -> Tr_No , Ticket_ID -> Ticket_Status , Ticket_ID -> Res_date ,

Ticket_ID -> Book_date, { PNR_No, Tr_No -> Ticket_Status } }

Find the Candidate Key

{Ticket_ID}$^+$ = {No_of_Passengers, User_ID , Tr_no , Ticket_Status , Res_date , Book_date }

Candidate Key CK { Ticket_ID }$^+$ = { No_of_Passengers , User-ID , Tr_no , Ticket_Status , Res_date , Book_date }

Prime Attributes PA { Ticket_ID }

Non-Prime Attributes NPA { No_of_Passengers , User-ID , Tr_no , Ticket_Status , Res_date , Book_date }

1NF : The User table contains no multivalued attribute. So it satisfy the 1NF

2NF: We need to check if there is any FD where the non-prime attribute is not fully functional dependent or in other words we have to find if there are any partial dependencies

Here there is no proper subset for a candidate key.

Here there is no partially dependencies that means fully dependencies exists. So TICKET Relation satisfy the 2NF

3NF: To check transitive dependencies (NPA -> NPA) in the relation.

Ticket_ID -> { No_Of_Passengers , UserID , PNR_No , Tr_No , Ticket_Status ,Res_date ,Book_date }

{ PNR_No }-> {Tr_No ,Ticket_Status }

We can observe that Ticket_ID which is Prime attribute derived the { No_Of_Passengers , UserID , PNR_No , Tr_No , Ticket_Status ,Res_date ,Book_date } which are non-Prime attribute. So Here there is no transitivity dependencies.

But the { PNR_No } which is non-prime attributes derived the Ticket_Status and Tr_No which are non-prime attribute. So Here there is transitivity dependencies. So it is on non 3NF So we have to Decompose the Relation into Two Relation

TICKET_BOOK (Ticket_ID, No_Of_Passengers , User_ID , PNR_No, Tr_No ,Res_date ,Book_date)

Ticket_ID -> No_Of_Passengers , Ticket_ID ->User_ID , Ticket_ID -> PNR_No , Ticket_ID -> Tr_No , Ticket_ID -> Res_date , Ticket_ID -> Book_date

TICKET_STATUS (PNR_No, Tr_No , Ticket-Status)

{ PNR_No }-> { Tr_No , Ticket_Status }

TICKET_BOOK

Ticket_ID	No_Of_Passengers	User_ID	PNR_No	Tr_No	Res_Date	Book_Date	U_Source	U_Dest

TICKET_STATUS

PNR_No	Tr_No	Ticket_Status

BCNF :

To check whether all the attributes are derived from the candidate Key or Super key

We can observe that all the non-prime attributes are derived from the Super Key attribute (Super key exists in the left side of all the FD's)

So TICKET_BOOK relation satisfy the BCNF

TICKET_STATUS

PNR_No	Tr_No	Ticket_Status

{ PNR_No }-> { Tr_No , Ticket_Status }

Candidate Key CK { PNR_No }$^{+}$ = { Tr_no , Ticket_Status }

Prime Attributes PA { PNR_No }

Non-Prime Attributes NPA { Tr_no , Ticket_Status }

3NF: To check transitive dependencies (NPA -> NPA) in the relation.

{ PNR_No }-> { Tr_No ,Ticket_Status }

We can observe that PNR_No which is Prime attribute derived the { Tr_No , Ticket_Status , } which are non-Prime attribute. So here, there is no transitivity dependencies. The Relation Ticket_Status satisfy the 3NF.

BCNF :

To check whether all the attributes are derived from the candidate Key or Super key

We can observe that all the non-prime attributes are derived from the Super Key attribute(Super key exists in the left side of all the FD's)

So TICKET_STATUS relation satisfy the BCNF

PAYMENT

Payment_ID	Ticket_ID	Amount

PAYMENT (Payment_ID , Ticket_ID , Amount)

PAYMENT (A , B , C)

FD's = { A - > B , A -> C ,B -> A , AC - > B, AB -> C}

A -> BC

B -> A

AC -> B

AB -> C

Minimal Set of FD'S :

To check whether A -> BC is need or not

Closure , $\{ A \}^+ = \{ A , B , C \}$

Ignore the FD A -> BC and Find the closure

$\{ A \}^+ = \{ A \}$

The FD A -> BCDEFG is needed

To check whether B -> A is need or not

Closure , $\{ B \}^+ = \{ B , A , C \}$

Ignore the FD A D -> E and Find the closure

$\{ B \}^+ = \{ B , C , A \}$

The FD B -> A is not needed

To check whether AC -> B is need or not

Closure , $\{ AC \}^+ = \{ A , C , B \}$

Ignore the FD AC -> B and Find the closure

$\{ B \}^+ = \{ A , C , B \}$

The FD AC -> B is not needed

To check whether AB -> C is need or not

Closure , $\{ AB \}^+ = \{ A , B , C \}$

Ignore the FD AB -> C and Find the closure

$\{ AB \}^+ = \{ A , B , C \}$

The FD AB -> C is not needed

Minimal FD's = { A -> BC }

FD'S = { Payment_ID -> Ticket_ID , Payment_ID -> Amount }

Find the Candidate Key

Candidate Key Ck $\{ Payment\_ID \}^+ = \{ Ticket\_Id , Amount \}$

Prime Attributes PA { Payment_ID }

Non-Prime Attributes NPA { Ticket_ID , Amount }

1NF: The User table contains no multi-valued attributes. So it satisfies 1NF.

2NF: We need to check if there is any FD where the non-prime attribute is not fully functional dependent or in other words we have to find if there are any partial dependencies .

Here there is no proper subset for a candidate key.

Here, there are no partially dependencies which means fully dependencies exists. So PAYMENT Relation satisfy the 2NF

3NF: To check transitive dependencies (NPA -> NPA) in the relation.

Payment_ID -> Ticket_ID , Payment_ID -> Amount

We can observe that Payment_ID which is Prime attribute derived the { Ticket_ID , Amount } which are non-Prime attribute. So Here there is no transitivity dependencies. The Relation PAYMENT satisfy the 3NF.

BCNF:

To check whether all the attributes are derived from the candidate Key or Super key

We can observe that all the non-prime attributes are derived from the Super Key attribute (Super key exists in the left side of all the FD's)

So PAYMENT relation satisfy the BCNF

FINAL_RELATIONS:

USER

User_ID	F_Name	L_Name	Age	Gender	Pin	Mobile_no

USER_ADDRESS

Pin	City	State

TRAIN

Tr_no	Tr_Name	Cap	Source	Dest	S_Time	Dest_Time

STATION

Tr_no	St_no	St_Name	Arr_Time	Dept_Time

TICKET_BOOK

Ticket_ID	No_Of_Passengers	User_ID	PNR_No	Tr_No	Res_Date	Book_Date	U_Source	U_Dest

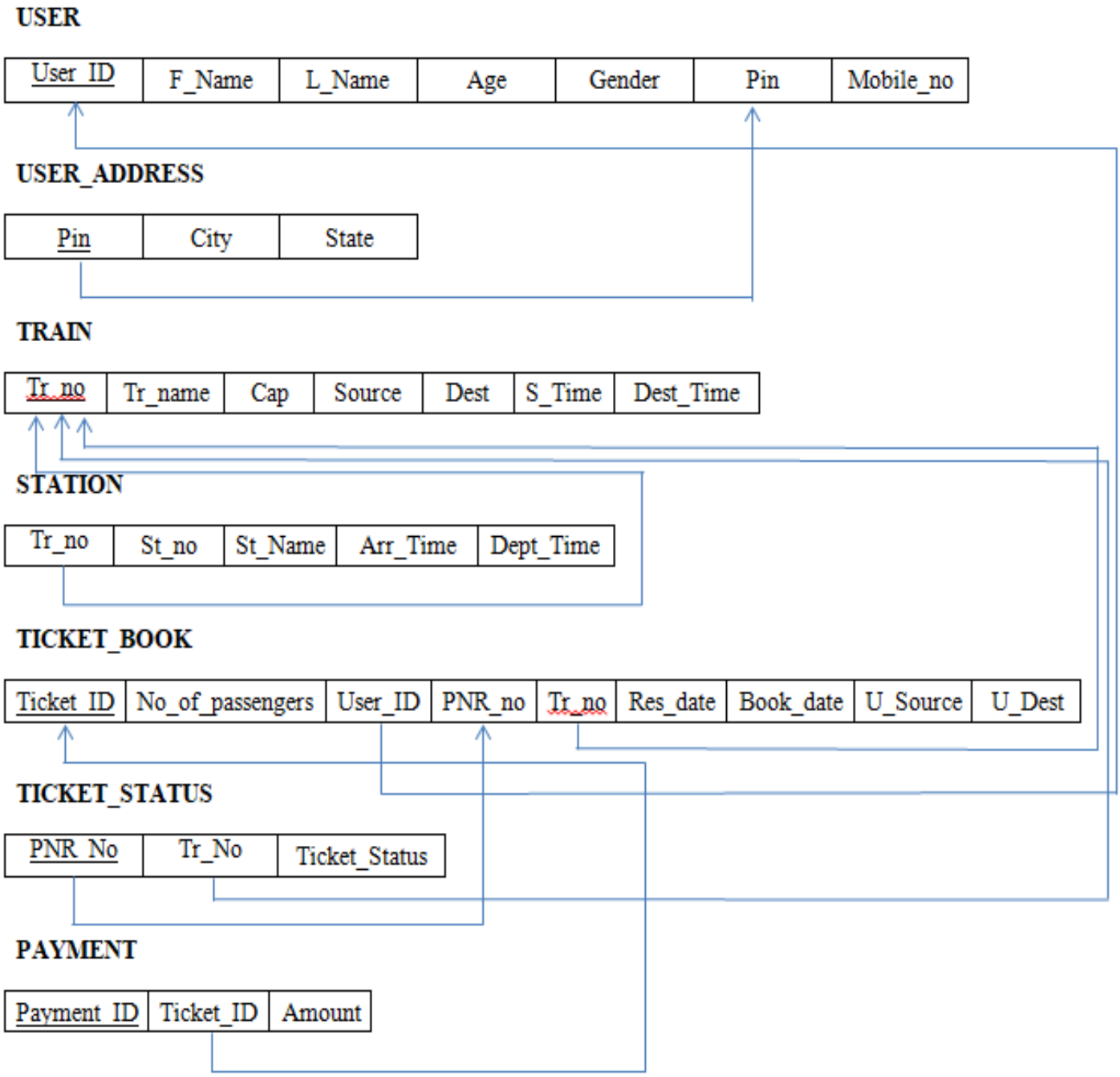
TICKET_STATUS

PNR_No	Tr_No	Ticket_Status

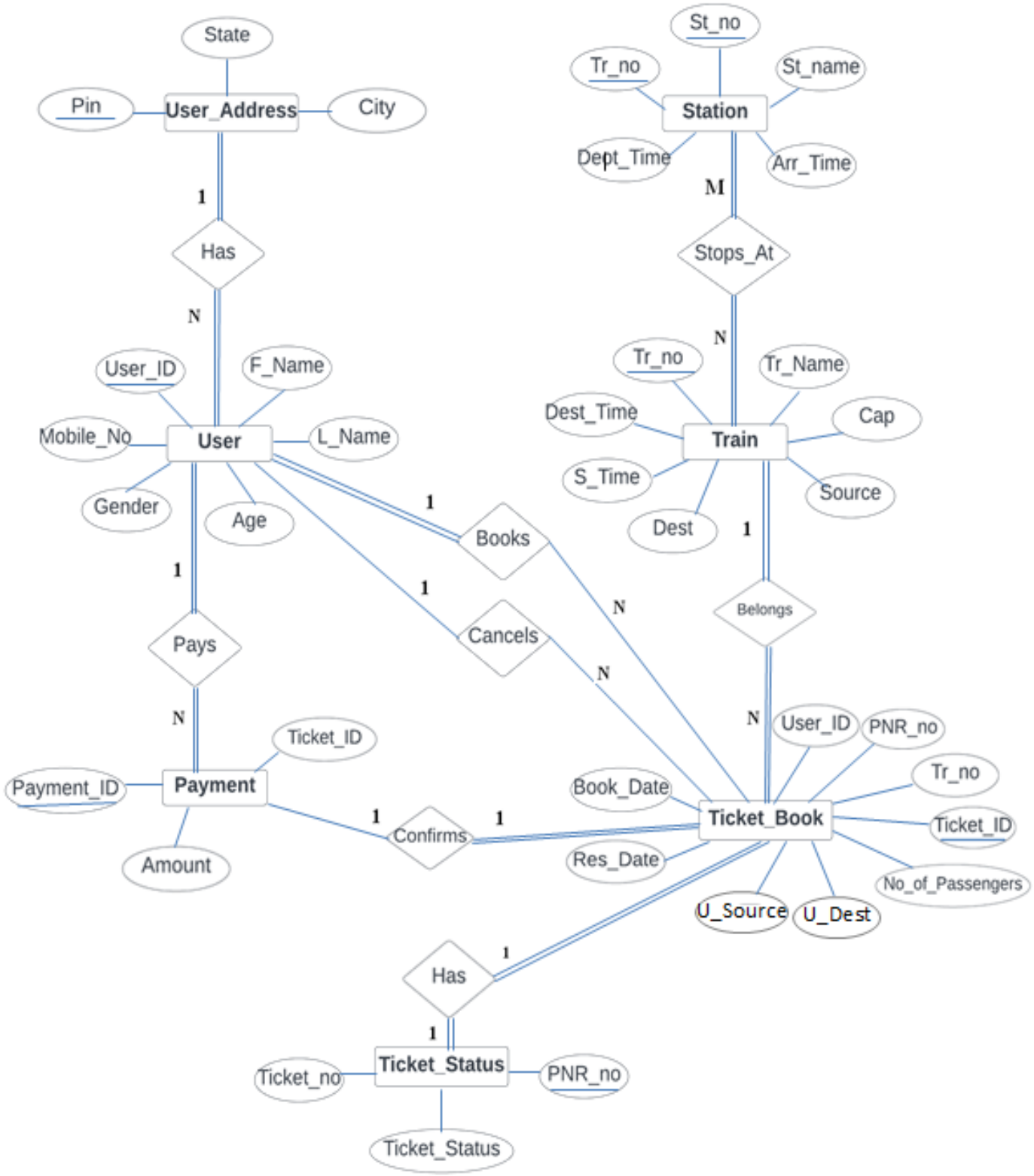
PAYMENT

Payment_ID	Ticket_ID	Amount

FINAL **SCHEMA DIAGRAM**

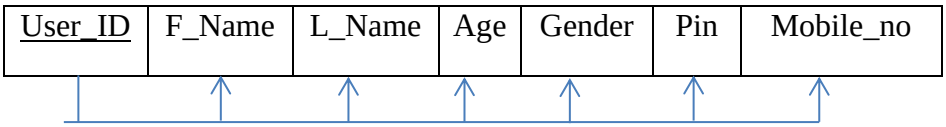


FINAL **ER – DIAGRAM** AFTER NORMALIZATION

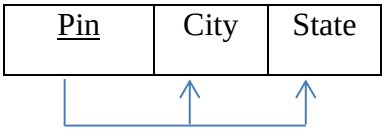


FDs AFTER NORMALIZATION

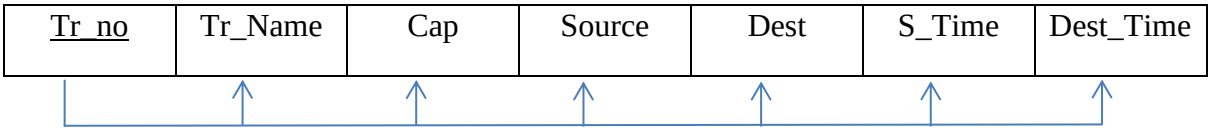
USER



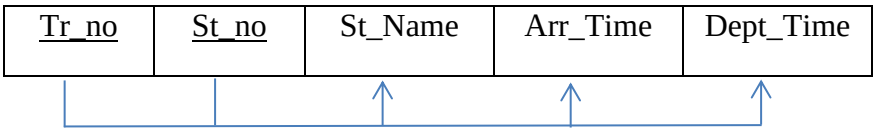
USER_ADDRESS



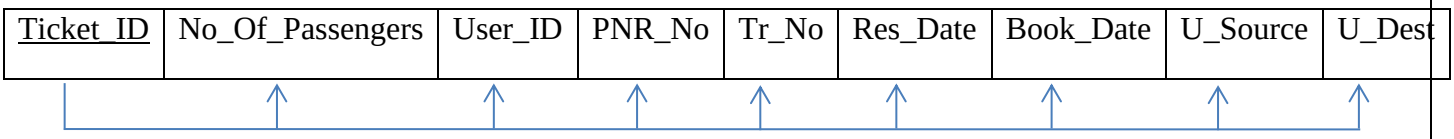
TRAIN



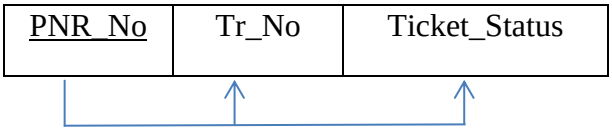
STATION



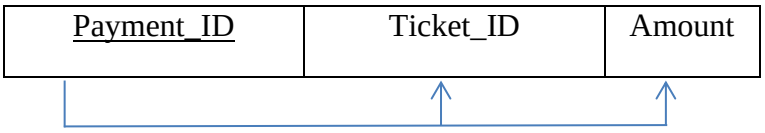
TICKET_BOOK



TICKET_STATUS



PAYMENT



THUS WE HAVE DEVELOPED A RAIWAY MANAGEMENT SYSTEM WITH THE HELP OF NORMALIZATION OF RELATIONS.