**Design of Relational DB**

**Signup:**

**Relation Schema:**

Below is the relation schema for Signup table

Signup = {userid, firstname, lastname, dob, ssn, email, password, role, driverslicense, username}

We use below abbreviations:

S = {uid, fn, ln, dob, ssn, email, pwd, role, dl, uname}

**Functional Dependencies for Signup table:**

uid -> fn, ln, dob, ssn, email, pwd, role, dl, uname.

**BCNF:** Yes, it is in BCNF.

**Reason:** For above non-trivial FD,LHS of FD is a super key. To verify the same, calculate the closure of uid. It determines all the attributes in Signup table.

{uid}+ = {uid, fn, ln, dob, ssn, email, pwd, role, dl, uname}.

**Login:**

**Relation Schema:**

Below is the relation schema for Login table

Login = {userid , username, password}

We use below abbreviations:

L = {uid, uname, pwd}

**Functional Dependencies for Login table:**

uid -> uname, pwd.

**BCNF:** Yes, it is in BCNF.

**Reason:** For above non-trivial FD,LHS of FD is a super key. To verify the same, calculate the closure of uid. It determines all the attributes in Login table.

{uid}+ = {uid, uname, pwd}.

**Customer:**

**Relation Schema:**

Below is the relation schema for Customer table

Customer = {cid, username, address, dob, ssn, phone\_number, annual\_income}

We use below abbreviations:

C = { cid, uname, add, dob, ssn, phno, ai }

**Functional Dependencies for Customer table:**

cid -> uname, add, dob, ssn, phno, ai.

**BCNF:** Yes, it is in BCNF.

**Reason:** For above non-trivial FD,LHS of FD is a super key. To verify the same, calculate the closure of cid. It determines all the attributes in Customer table.

{cid}+ = {cid, uname, add, dob, ssn, phno, ai}.

**Manager:**

**Relation Schema:**

Below is the relation schema for Manager table

Manager = {mid, username, phone\_number, address1, address2, city, state, postalcode, country}

We use below abbreviations:

M = {mid, uname, phno, add1, add2, city, state, pc, country}

**Functional Dependencies for Manager table:**

mid -> uname, phno, add1, add2, city, state, pc, country

pc -> city, state, country

**BCNF:** No, it is not in BCNF.

**Reason:** For above non-trivial FDs, LHS of FD should be a super key. To verify the same, calculate the closure of mid and pc. mid determines all the attributes and pc does not determine all attributes.

{mid}+ = {mid, uname, phno, add1, add2, city, state, pc, country}.

{pc}+ = {pc, city, state, country}.

**3NF:** No, it is not in 3NF.

**Reason:** mid is the only available candidate key.For above FDs. LHS of 2nd FD pc is not a super key and RHS does not contain any candidate keys.

**3NF Decomposition:**

**Minimal cover:**

mid -> uname, phno, add1, add2, city, state, pc, country

pc -> city, state, country

From above FDs, we can conclude that **{**city, state, country} is extraneous in first FD as it is determined by pc in second FD. Remove those attributes from RHS of first FD.

Modified FDs will be as below which is minimal cover of above FDs

mid -> uname, phno, add1, add2, pc

pc -> city, state, country

The decomposition is R1 = {mid, uname, phno, add1, add2, pc}

R2 = {pc, city, state, country}

**Validation of Candidate Keys:** R1 contains a candidate key mid. So, the final decomposition is

R1 = {mid, uname, phno, add1, add2, pc}, R2 = {pc, city, state, country}. mid and pc are super keys for R1 and R2.

{mid}+ = {mid, uname, phno, add1, add2, pc}

{pc}+ = {pc, city, state, country}

Both R1 and R2 are in BCNF and 3NF. Decomposition is lossless and dependency preserving.

**Inventory:**

**Relation Schema:**

Below is the relation schema for Inventory table

Inventory = {vehicleid, make, model, price\_range, color, type, year\_added\_to\_inventory}

We use below abbreviations:

I = {vid, mk, mdl, price, col, type, year}

**Functional Dependencies for Inventory table:**

vid -> mk, mdl, price, col, type, year

**BCNF:** Yes, it is in BCNF.

**Reason:** For above non-trivial FD,LHS of FD is a super key. To verify the same, calculate the closure of vid. It determines all the attributes in Inventory table.

{vid}+ = {vid, mk, mdl, price, col, type, year}.

**Accounting:**

**Relation Schema:**

Below is the relation schema for Accounting table

Accounting = {vehicleid, purchase\_id, cid, mid, year}

We use below abbreviations:

A = {vid, pid, cid, mid, year}

**Functional Dependencies for Accounting table:**

vid -> pid, cid, mid, year

**BCNF:** Yes, it is in BCNF.

**Reason:** For above non-trivial FD,LHS of FD is a super key. To verify the same, calculate the closure of vid. It determines all the attributes in Accounting table.

{vid}+ = {vid, pid, cid, mid, year}.

**Purchase:**

**Relation Schema:**

Below is the relation schema for Purchase table

Purchase = {purchase\_id, cid, vehicleid, mid, purchase\_date, shipping\_address, purchase\_status, price, paymentmethod}

We use below abbreviations:

P = {pid, cid, vid, mid, pdate, sadd, pstatus, price, paym}

**Functional Dependencies for Purchase table:**

pid -> vid, pdate, sadd, pstatus, paym

vid -> price, pid, cid, mid

**BCNF:** Yes, it is in BCNF.

**Reason:** For above non-trivial FDs, LHS of FD should be a super key. To verify the same, calculate the closure of pid and vid. It determines all the attributes in Purchase table.

{pid}+ = { pid, vid, pdate, sadd, pstatus, paym**,** price, cid, mid}.

{vid}+ = { vid, price, pid, cid, mid, pdate, sadd, pstatus, paym}.

**Card Details:**

**Relation Schema:**

Below is the relation schema for Card\_details table

Card\_details = {card\_type, card\_no, name\_on\_the\_card, expiry\_date, pin\_no}

We use below abbreviations:

CD = { cdno, ctype, cdname, expdt, pin}

**Functional Dependencies for Card\_details table:**

cdno -> ctype, cdname, expdt, pin

**BCNF:** Yes, it is in BCNF.

**Reason:** For above non-trivial FD,LHS of FD is a super key. To verify the same, calculate the closure of cdno. It determines all the attributes in Card\_details table.

{cdno}+ = {cdno, ctype, cdname, expdt, pin}.

**Car Information:**

**Relation Schema:**

Below is the relation schema for Car\_information table

Car\_information = {vehicleid, price, name, modelyear, type, engine, transmission, incentives, interestrate, downpayment, mileage}

We use below abbreviations:

CI = {vid, price, name, myear, type, eng, transm, incen, intr, dp, mil}

**Functional Dependencies for Car\_information** **table:**

vid -> price, name, myear, type, incen, intr, dp

type ->eng, transm, mil

**BCNF:** No, it is not in BCNF.

**Reason:** For above non-trivial FD,LHS of FD should be a super key. To verify the same, calculate the closure of vid and type. type does not determine all the attributes in Car\_information table.

{vid}+ = {vid, price, name, myear, type, eng, transm, incen, intr, dp, mil}.

{type}+ = {type, eng, transm, mil}.

**3NF:** No, it is not in 3NF.

**Reason:** vid is the only available candidate key.For above FDs. LHS of 2nd FD type is not a super key and RHS does not contain any candidate keys.

**3NF Decomposition:**

**Minimal cover:**

vid -> price, name, myear, type, incen, intr, dp

type ->eng, transm, mil

The decomposition is R1 = {vid, price, name, myear, type, incen, intr, dp}

R2 = {type, eng, transm, mil}

**Validation of Candidate Keys:** R1 contains a candidate key vid. So, the final decomposition is

R1 = {vid, price, name, myear, type, incen, intr, dp}, R2 = {type, eng, transm, mil}. vid and type are super keys for R1 and R2.

{vid}+ = {vid, price, name, myear, type, incen, intr, dp}

{type}+ = {type, eng, transm, mil}

Both R1 and R2 are in BCNF and 3NF. Decomposition is lossless and dependency preserving.