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Assignment - 4

1) Trivial Functional Dependency

⇒ A functional is trivial iff

$X \longrightarrow Y$ and if $Y \subseteq X$
(attributes) (attributes)

eg ⇒ R ⇒ {S-id, Sname, Sage}

{S-id, Sname} → name is a trivial function dependency.

2) Non trivial Functional Dependency

⇒ If X → Y and Y is not a subset of X, then it is called non-trivial functional dependency.

eg ⇒ R ⇒ {S-id, Sname, Sage}
S-id → Sname is a non-trivial functional dependency.
Since the dependent Sname is not a subset of {S-id, Sname}.

3) Transitive functional Dependency

Dependency is indirectly dependent on determinat.

i.e ⇒ If a → b & b → c then according to axiom of transitivity a → c this is a transitive f.D.

eg ⇒ {S-id; Sname, S-dept, S-building-no}

S-id → {S-dept} and S-dept → S-building-no.
Here {S-id → S-building-no.} is valid F.d.

→ 1NF → if a table does not have multivalued attributes then it is said to be in 1NF

i.e → if every attribute in that relation is singled valued attribute.

→ 1) Are only single valued Attribute
2) Attribute Domain does not change.
3) There is a unique name for every Attribute
4) The order in which data is stored does not matter.

eg-1 R → {Student} table 1

Stud_no	Stud_name	Stud_State	S_No.
1	AD	U.P	+91 063 XX, +91 843 XX
2	AD	U P	+91 745 XX
3	Yash	Punjab	—

↓↓ Into 1NF

Stud_no	Stud_name	Stud_state	S_no.
1	AD	U.P	+91 063 XX
1	AD	U.P	+91 843 XX
2	AD	U.P	+91 745 XX
3	Yash	Punjab	—

→ 2NF if all the non prime attribute are fully F.D on the candidate key. then table is in 2NF. (given table follows 1NF as well)

eg → R(A, B, C, D)

AB → C [A and B together determine C]

BC → D [B and C together determine D]

AB is the only candidate key and there is no partial dependency. i.e any proper subset of AB doesn't determine non prime attribute.

→ 3NF → if a table is in 2NF and also none of the prime attributes refer to other non prime attribute, then the table is in 3NF.

eg → R{A, B, C, D, E}

→ A → BC CD → E , B → D , E → A.

all possible candidate key in above Relation are {A, E, CD, BC}
all attribute are on right side of all F.D are prime.

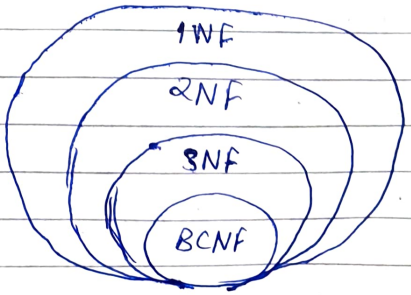
→ BCNF anyone of the condition →
i) X → Y; Trivial F.D
ii) X → Y, X is a super key.
iii) X → Y, then (Y-X) is prime attribute

→ BCNF it is strict version of 3NF
Here both conditions need to be true.

i) X → Y, Trival F.D
ii) X → Y, X is a super key.

~~eg → {BC → D, AC → BE, B → E}~~
eg → R(A, B, C)
FD → A → BC , B → A.
A and B both are super keys so above relation is in BCNF.

Normal form Hierarchy.



Q2 $R = \{P, Q, R, S, T, U, V, W, X, Y, Z\}$

$F \Rightarrow \{\{P,R\} \to \{Q\}, \{R\} \to \{S,T\}, \{R\} \to \{U\}, \{U\} \to \{V,W\}, \{S\} \to \{X,T\}, \{U\} \to \{Z\}\}$

Key for R? ⇒

$\{P,R\}$ is the key because it is the only CK and it is ~~the~~ satisfies the requirement for key.

$\{P,R\}^+ \Rightarrow \{P,Q,R,S,T,U,V,W,X,Y,Z\}$

⇒ No proper subset of $\{P,R\}$ i.e.

$\{P\}^+ \Rightarrow \{P,S,T,X,Y\}$

$\{R\}^+ \Rightarrow \{R,U,V,W,Z\}$

∴ PR is a CK with Prime attributes ⇒ $\{P\,R\}$
and Non Prime attributes ⇒ $\{Q,S,T,U,V,W,X,Y,Z\}$

R is 2NF? ⇒ No, because $\{P\} \to \{S,T\}$
we know if Proper subset of C.K

F.D ⇒ $\{P \to SR, R \to U\}$

$P^+ \Rightarrow PSTXY$ $\quad R_1 \Rightarrow \{PSTXY\}$
$R^+ \Rightarrow RUVWZ$ $\quad R_2 \Rightarrow \{RUVWZ\}$

$R_3 \Rightarrow \{QRR\}$.

∴ Now in 2NF.

$\Rightarrow FD_{R_1} \Rightarrow \{R \to STXY,\ S \to XY\}$

$FD_{R_2} \Rightarrow \{R \to UVWZ,\ U \to VWZ\}$

$FD_{R_3} \Rightarrow \{PR \to Q\}$
$\to \{PSTXY\}$

In this we have $P^+ \Rightarrow STXY$ not part of R_3
$R^+ \Rightarrow UVWZ$ not part of R_3
$PR^+ \Rightarrow PQR \to \{RUVWZ\}$
$QR^+ \Rightarrow QRSTXY$
$QR^+ \Rightarrow QRUVWZ$.

In 3NF, we can have $\Rightarrow$ { 1) LHS of FD can be CK or SK
2) RHS is a prime attribute }

∴ R_2 can be broken down to.

$R_2' \Rightarrow RU$ $\quad R_2'' = UVWZ.$
$R \to V$ $\quad U \to W$ $\quad V \to Z$

We know BCNF $\Rightarrow$ { 1) $X \to Y$, trival F.D
2) $X \to Y$; X is a super key }.

So $R_1 \Rightarrow \{PSTXY\}$ can be broken into.

$R_1' \Rightarrow \{PST\}$ $FD \Rightarrow \{P \to ST,\ S \to XY\}$.
$R_1'' \Rightarrow \{SXY\}$ $FD \Rightarrow \{S \to XY\}$.

Therefore R can be broken down into 3 tables in 3NF and no further decomposition possible.

$R_3 = PQR$ $\quad R_1' = PST$ $\quad R_1'' \Rightarrow SXY$, $R_2' = RU$ $\quad R_2'' = UWZ$

Q3 Schema ⇒ Employees (Aadhar no, Union ID)
Technician (Name, Salary, address, Phone no, Addhar no)
test (Test no, Test name, Max score)
Bus (Reg no)
Union (Union name, Union ID)
Model (Model name, Model no, Capacity)
Testing (Reg no, Test no, Date, hours, Score)
Expert (Aadhar no, Model No).

F.D of each Relations and C.K)

① Employees ⇒ F.D ⇒ {Aadhar ⇒ Union ID}

② Tech ⇒ FD ⇒ {aAdhar → name, name, Salary, address, Ph. no}

③ Tests ⇒ FD ⇒ {Test no → Test name, Max score}

④ Union ⇒ FD ⇒ {Union ID → Union name}

⑤ Model ⇒ FD ⇒ {Model no → Model name, Capacity}

⑥ Testing ⇒ FD ⇒ {Reg no, Test no, Date → hours, Score}

⑦ Expert IN ⇒ FD ⇒ {Aadhar no → Model no}.

~~Model and Bus ⇒ have 1:m Relationship.~~

~~FD ⇒ R1~~ R1 ⇒ Bus {Reg No, Model No}

FD ⇒ Reg No → Model no.

R2 ⇒ Model: (Model no, capacity)

F.D ⇒ Model no → capacity.

R3 → Technician (Name, Aadhar, address, PNo, Salary

FD → Aadhar → Name, address, PNo, Salary.

R_4 → Expert (Aadhar, Model no.)

FD → Aadhar → Model no
Model no → Aadhar

R_5 → Test → (TNo, Tname, Maxscore)

FD → TNo → MaxScore.
TName → TNo
TNo → TName
TName → maxscore

R_6 → Testing (RegNo, adhar, TNo, date, Hours, Score)

FD → T.No, Reg No, Aadhar, date → Hours, Score.

R_7 → Union (Aadhar, Umeno.)

FD → Aadhar → Umen no.
Umen no → Aadhar.