Lec-11

Normalization ?

Functional dependency

$A \rightarrow B$

Determinant

dependent

$A \rightarrow C$

Table

A	B	C	D
1	2	1	5
2	4	5	6

eg. Emp

Emp_id	name	dept.	address.

FD :-

Emp_id $\longrightarrow$ Emp_name.

Emp_id $\longrightarrow$ dept

1 Trivial F.D :- $A \rightarrow B$, B is a subset of A.

eg. {EMP_ID, Name} $\longrightarrow$ Emp_ID

eg. $A \rightarrow A$, $A \subseteq A$

$B \rightarrow B$ $\quad$ $B \subseteq B$

(2) Non-Trivial F.D :->

{EMP_ID, name} -> {Emp_addr}

$A \rightarrow B$

Q. $B \subseteq A$? -> NO,

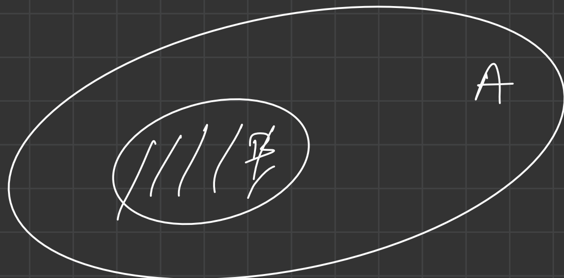
=> This is N.T.F.D

=> $A \rightarrow B$, $B \not\subseteq A$, $A \cap B = NULL$,

EMP_id -> emp_dept

Venn diagram

T.F.D



N.T.F.D

$A \cap B = \text{NULL}$.

① Reflexive

$X = \{a, b, c, d, e\}$

subset $Y = \{a, b, c\}$

$\Rightarrow$ Y is a subset X,

$X \rightarrow Y$.

② Augmentation

$\rightarrow$ $X \rightarrow Y$ $\qquad$ $R(X\,Y, Z)$

$XZ \rightarrow YZ$

Q $R(A\ B\ C\ D\ E)$

$A \to B$

$A \to C$

$CD \to E$

$B \to D$

$E \to A$

w =

w =

$BC \to CD \implies B \to D$, ✓

$EC \to AC$? $\implies$ ✓

$BD \to CD \implies$ $B \to C$?? ✗ ✓

Q $R(A, B, C, D, E)$

FD :- $A \to B$

$A \to C$

$CD \to E$

$B \to D$

$E \to A$

Can

$CD \to AC$??

$\Rightarrow$ $CD \to E$ & $E \to A$ $\Rightarrow$ $CD \to A$ (transitivity)

$C \subseteq CD \Rightarrow CD \to C$

So, $CD \to A$ & $CD \to C$

$\Rightarrow CD \to AC$ ✓

Why Normalisation

=> What if we have redundant data?

-> introduces 3 anomalies -> abnormalities

=> 1. Insertion
2. deletion
3. updation / modification

student

id	name	age	Branch_code	Branch_name	Branch_HOD
1	A	18	1	CS	X
2	B	19	1	CS	X
3	C	18	1	CS	X
4	D	21	2	ECE	Y
5	E	20	2	ECE	Y
6	F	19	3	M.E	Z

1 Insertion

=> New student.

=> University → 'IT'

2) Deletion

3) updation :-

HOD change CS → Q.

⇒ id | name | age | Brcode   Table 1

Table 2   Branch info

Brcode	Branch name	HOD name
1	CS	X
2	ECE	Y
3	ME	Z
4	IT	Q

What we do in normalization

⇒ Table → decompose → into multiple tables.

$\boxed{\text{SRP}}$ → Single responsibility principle.

1NF

eg.

emp.

id	name	Phone
1	A	88
2	B	12, 99

$\downarrow$ 1NF

id	name	Phone
1	A	88
2	B	12
2	B	99

2NF →

R(A B C D)

⇒ {AB} → P.K

A, B → prime attributes,

C, D → Non-prime.

⇒ FD ⇒ B → C ← Partial dependen.

~ AB → C ✓✓

AB → D

A	B
Null	1
2	Null
~~Null~~	~~Null~~
3	4

{AB} P.K.

$B \rightarrow C$

Null $\rightarrow$ C ?? X

2NF Conversion

$R_1(ABD)$ $AB \rightarrow D$

$R_2(BC)$ $B \rightarrow C$

2NF Table (Student Project)

Student ID	Proj ID	Student Name	Project name
S89	P09	Aria	Geo
S76	P07	Jacob	Chites
S56	P03	Ava	IOT
S92	P05	Alex	Cloud.

P.K : { Student ID, Proj ID }

FD :→

Student ID ⟶ Student Name

Project ID ⟶ Project Name

2NF form

Student

Student ID	Project ID	Student Name
S89	P09	Olvia
S76	P07	Jacob
S56	P03	Ava
S92	P05	alex

Project

Project ID	Project Name
P09	Geo
P07	Cluster
P03	IOT
P05	Cloud

3NF

R(A B C)

P.K { A }

F.D :- A → B

B → C

2NF ✓

⇒

A	B	C
a	1	x
b	1	x
c	1	x
d	2	y
e	2	y
f	3	z
g	3	z

A → Prime.

B → C

Nonprm.

Prime.

$B \rightarrow C$ — F.D (Transitive dependency)

=> decompose 3NF

$R_1(\underline{A}\ B)$ $R_2(\underline{B}\ C)$

R_1

A	B
a	1
b	1
c	1
d	2
e	2
f	3
g	3

B	C
1	x
2	y
3	z

BCNF

eg.

Stud_ID	Subject	Professor
101	Java	PJ
101	CPP	PC
102	Java	PJ2
103	C#	PC#
104	Java	PJ

- One student can enroll in multiple subjects
- for each subject, a professor is assigned to a student
- multiple professor can teach a single subject
- One professor can teach only one subject.

P.K = ? {Stud_ID, subject}

1. {Stud_ID, subject} $\longrightarrow$ Professor.
2. Professor $\longrightarrow$ subject

⇒ BCNF Conversion

Student

id	p-id
101	1
101	2
!	!
!	!

Professor

p-id	Professor	subject
1	PJ	Java
2	PC	CPP.
!		!
!		