22/02/23

Closure of an attribute

↳ given a (FD) set
Set of all attributes which are implied by the attribute.

$X^+ = X$

do {
  old $X^+ = X^+$
  for each F.D f_i in F.D set F,
    IF L.HS of $f \subseteq X^+$
      $X^+ = X^+ \cup$ RHS of f
} while (old $X^+ != X^+$)

~~If old X^+~~

Candidate key : K $\Rightarrow$ $K^+ = \xi$ (Universal Set of Attributes -> Relation)

Cover of a FD set: A F.D set F_c covers the FD set F if each F.D $f \in F$ is in F_c^+

F_g | F

$A \to B$
$B \to C$
$A \to C$

F_c

$A \to B$
$B \to C$

Minimal cover: by removing the redundancy in F.D

Canonical form of a fun dependency

$XYZ \to C_1 C_2$
⇓
$XYZ \to C_1$
$XYZ \to C_2$
(decomposition)

① ~~PUT~~ FDs in canonical form.
② Find & redundancy in FDs.
  (a) If there is any redundant attribute on RHS of FD, then remove those.
  $X \to Y \Rightarrow [X - \{A\}] \to Y$ if A is dependent on X

(b) F.D is redundant $\Rightarrow$ $F \Rightarrow (F - \{x \to y\})^+$

Normalisation: The formal approach for designing database based on the concept of key and functional dependency.

Prime attribute: An attribute which is part of at least one candidate key

To minimize update anomalies
occurance of NULL values
and redundancies

⇓

A complex structure will be broken into number of single schema/relation.

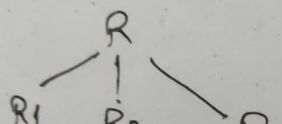
ER Diagram

↓

Relations (R. model)

⇅

Normalization: Check with individual relation.



Less Less join: while joining the decomposed relation, it must not give rise to spurious tuples

must be dependency preserving

X normal form: Highest normal form it satisfies.

Designer may restrict the design to lower normal form.

↳ denormalisation

Eg: Roll 4 grade → roll number to grade often req.

∴ Roll → ~~grade~~ score → grade

(1) ⟵ one table ⟶

1st NF (Not related with FD, each attr. must be atomic & single valued)

↓

2nd

↙ ↘

3rd BCNF

↘ ↙

4th.

~~Node~~ NORMALIZATION

27/02

For every student unique roll number

⇓ store

student(Roll, Name, ph.no, city, {scode, sname, stype, FM, PM, SCORE, FAC-ID, FAC-NAME, FAC-PH})

1st normal form : ~~It~~ F.D has no ~~se~~ role.

↳ Every attribute must be atomic and single valued

if composite, break it into components

Eg: DOB → DT-DOB, MON-DOB, YR-POB

if multivalued ↓ remove from original ~~relation~~ relation. ↓ In new relation copy the primary key (F.K in new relation)

for Each such independent ~~set~~, create relations ← For RELATD ATTR that RELATE together

Full

∴ Student → 1st normal form

Student (Roll, Name, Ph-no, CITY, DOB)

New → SUBJECT (ROLL, scode, SName, Stype ---)
(FK)

∴ **FDs**

ROLL → Name, Ph-no, city, dob

SCODE → SName, Stype, FM, P.M, FAC-ID

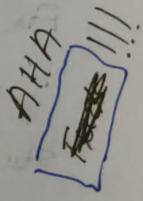
Fac-ID → FName, F-ph

ROLL, SCODE → Score

Subject (Roll, scode, Sname, Stype, FM, PM, Score, FacID, FNam, FPH)

(2nd normal form)

2NF : Partial dependency



$X \rightarrow Y$ if $A \subset X$ & $X - [A] \rightarrow Y$ holds

then Y is partially dependent on X

otherwise → fully functionally dependent.

JSR

A relation is in 2NF if every non prime attribute is fully functionally dependent on key

→ if key is simple → already in 2NF

∴ **Student is in 2NF**

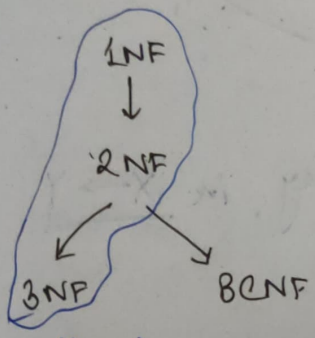
→ Subject: only score is fully functionally dependant on both roll & scode

→ Not in 2NF (remove others and copy part of key on which they depend)

∴ 2NF : ~~SDVD~~

student (Roll, Name, Ph-no, city, dob)
subject (scode, sname, stype, FM, PM, EID, FNam, F-PH)
Result (Roll, scode (FK), Score)

new



preffered

2NF : new relation has referenced key
1NF : new relation has referencing key

3NF: relation is in 3NF, if for every F.D, X → Y that holds on the relation, either of the following is true
→ X is super key
→ Y is prime.

Violating condition
! (X (super) ~~&&~~ or Y (prime))

⇒ X is not candidate and Y is not prime.

(2NF vio) ∴ ~~XX~~ X is part of cand (prime)
or
X is not prime attr.

∴ X & Y are both non prime

∴ Z → X → Y
non prime

To be in 3NF, relation must be in 2NF and ∄ no transitive dependencies

∴ reduce transitive dependency

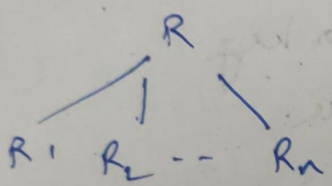
Subject (SCODE, SNAME, STYPE, FM, PM, F_ID)
FK

Faculty (FID, FAC-NAME, F_PH)

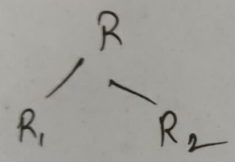
BCNF : Holds, only if $X \rightarrow$ superkey in $X \rightarrow Y$
(more strict)

so from the relation, remove Y, in a new rel, ~~copy~~ copy X
X is PK in new relation.
X is FK in old relation

Decomposition must be loss less.



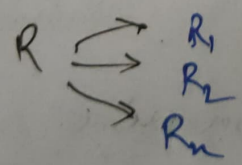
$\Rightarrow R_1 * R_2 * \dots R_n \rightarrow R$

$\therefore$ 

$\Rightarrow R_1 \cap R_2 \rightarrow R_1$
or
$R_1 \cap R_2 \rightarrow R_2$

Upto BCNF $\rightarrow$ Decomposition preserving.

F.D set F defined on universal relation R (all attr)



Let F_i be the projection of F on R_i

Set of F.D in F whose LHS & RHS attributes are in R_i

$\boxed{\cup F_i = F'}$

$\therefore F'^{+} = F^{+} \Rightarrow F'$ & F are equivalent.

$\therefore$ F.D preserving then.

3NF	BCNF
Both removes ~~dep~~ redundancy	
Both are lossless.	
Dep preserving	may not be dep. pres.

Attribute preservation

- Each attribute of R must appear once in the decomposed.

What if ph no, not separated

↳

Roll	PH	Scode
1	P1	S1
1	P2	S2
1	P1	S3
1	P2	S1
1	P1	S2
1	P2	S3

Reason

Multiple 1:N

meaningless

↳ 4th NF