NORMALIZATION
(Practice Questions)

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Steps to find the highest normal form of a relation

- Find all possible candidate keys of the relation.
- Divide all attributes into two categories:
  - prime attributes ,
  - non-prime attributes.
- Prime attribute are those attribute which are part of candidate key .
- Check for BC Normal form then 3NF and so on. If it fails to satisfy n^{th} normal form condition, check for n-1 normal form .

Test for BCNF

All determinants should be primary key.

Test for 3 NF

- No transitivity

Or

- Functional Dependency, LHS→RHS is in 3 NF if LHS is candidate key or RHS is prime attribute

Test for 2NF

- No partial dependency.

Ex-1

Consider the relation R(A,B,C,D) with set of functional dependencies {A→B, B→C,C→D}.

Relation is in which normal form?

Candidate key is A ,as it is not in RHS of any FD.

Prime attribute-A

Non Prime attribute : B,C,D

	A→B	B→C	C →D	
BCNF	Y	N	N	Not in BCNF
3 NF	Y	N	N	Not in 3 NF
2 NF	Y	Y	Y	In 2 NF

Thus, R is in 2 NF

Ex-2

Find the highest normal form of a relation R(A,B,C,D,E) with FD set {A->D, B->A, BC->D, AC->BE}

Attributes on RHS are (ABDE) thus essential attribute is C.

Super key (ABCDE) can be reduced to:

(ABCE) as A →D

(AC) as AC→BE

(BC) as B→ A

Thus BC and AC are candidate keys

Prime attribute :{A,B,C} , Non-prime {D,E}

	A->D	**B->A**	**BC->D**	**AC->BE**	
BCNF	N	N	Y	Y	Not in BCNF
3 NF	N	Y	Y	Y	Not in 3 NF
2 NF	Y	Y	N	Y	Not in 2 NF

BCNF-no as A and B are determinant but not candidate key.

3 NF-no

2 NF-The relation is not in 2nd Normal form because A->D is partial dependency (A which is subset of candidate key AC is determining non-prime attribute D) and 2nd normal form does not allow partial dependency.

Thus relation is in 1 NF

Ex-3

Find the highest normal form of a relation R(A,B,C,D,E,F) with FD set

{AB->CDEF , BD->F}

Here AB is candidate key

Prime attribute:{A,B}

Non-prime attributes {C,D,E,F}

	AB->CDEF	**BD->F**	
BCNF	yes	no	Not in BCNF
3NF	yes	no	Not in 3NF
2NF	yes	yes	Relation in 2 NF

Ex-4

Find the highest normal form of a relation R(A,B,C,D,E) with FD set **{BC->D, AC->BE, B->E}**

BDE are on RHS of FD , AC are essential attributes

Is AC candidate key?

$\{A,C\}^+ = \{A,B,C,D,E\}$, So AC is candidate key

Prime attribute:{A,C} , Non-prime attributes {B,D,E}

	BC→D	**AC->BE**	**B→E**	
BCNF	No	Yes	No	Not in BCNF
3NF	No	Yes	No	Not in 3NF
2NF	Yes	Yes	Yes	Relation in 2 NF