

# Normalization × Normal Forms

Normalization is done through decomposing tables based on series of normal forms.

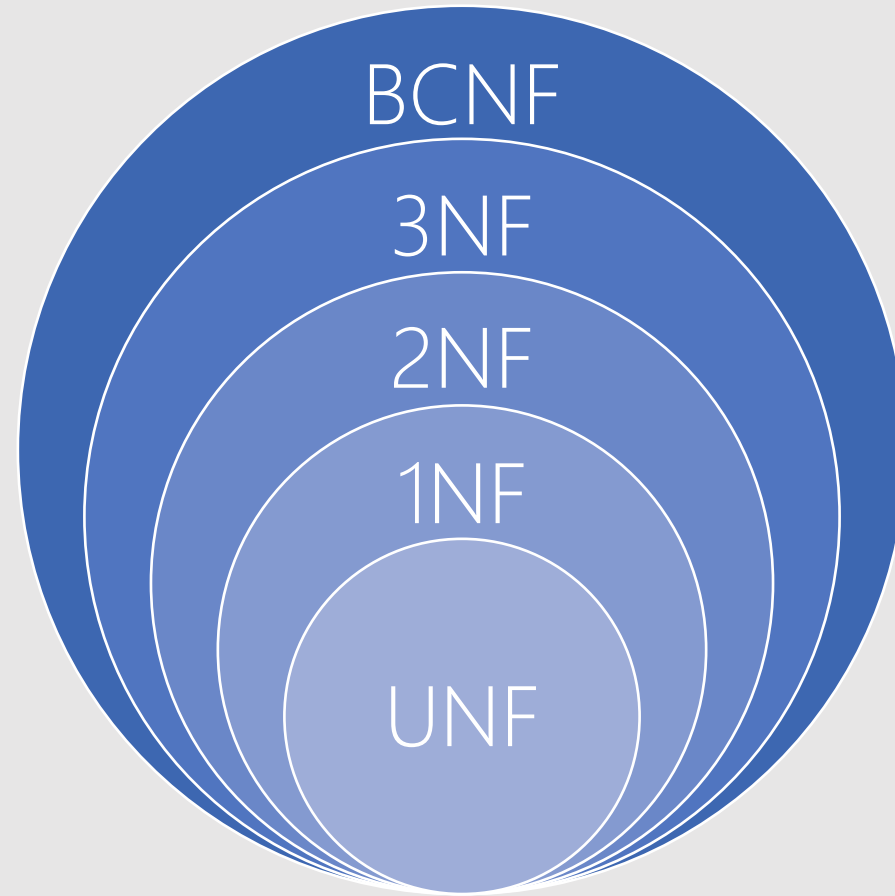
There are 11 normal forms:

UNF (1970)	1NF (1971)	2NF (1971)	3NF (1971)	EKNF (1982)	BCNF (1974)	4NF (1977)	ETNF (2012)	5NF (1979)	DKNF (1981)	6NF (2003)
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But we only consider UNF, 1NF, 2NF, 3NF and BCNF.

# Normalization × Normal Forms

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# Normalization × U-1,2,3NF

U-1NF: Requiring existence of "the key" in the table

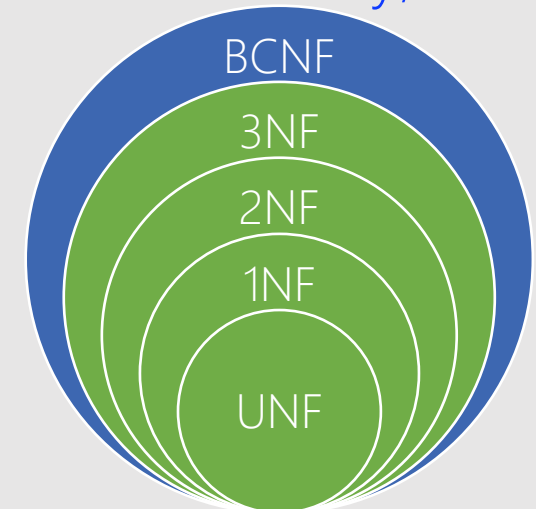
2NF: Requiring that non-key attributes be dependent on "the whole key"

3NF: Requiring that non-key attributes be dependent on "nothing but the key"

○ Both 2NF and 3NF are concerned equally with ALL Candidate Keys of a table and not just any one key

○ If there is no non-key, i.e., all attributes are part of at least a candidate key, then table is already in 2NF and 3NF.

○ In 3NF, a non-key attribute is able to be a determinant of a key attribute!

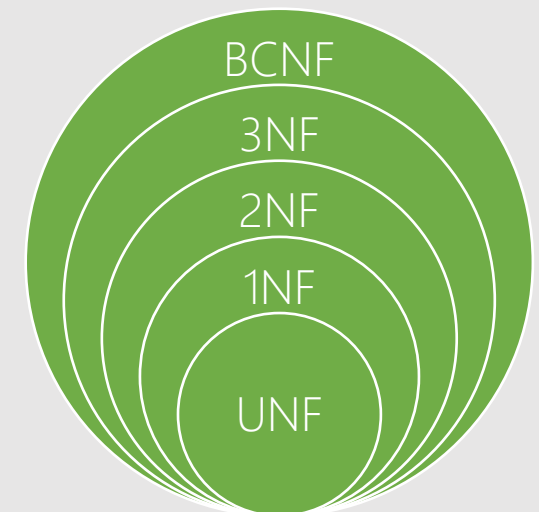


# Normalization × BCNF

Boyce-Codd NF | BCNF | 3.5NF, requires that at least one of the following conditions hold for all functional dependencies like  $X \rightarrow Y$  of a table:

- I)  $X \rightarrow Y$  is trivial, i.e.,  $Y \subseteq X$
- II)  $X$  is a Super Key (*left side must be super key!*)

The difference between BCNF and 3NF is ...



# Normalization × BCNF

Boyce-Codd NF | BCNF | 3.5NF, requires that at least one of the following conditions hold for all functional dependencies like  $X \rightarrow Y$  of a table:

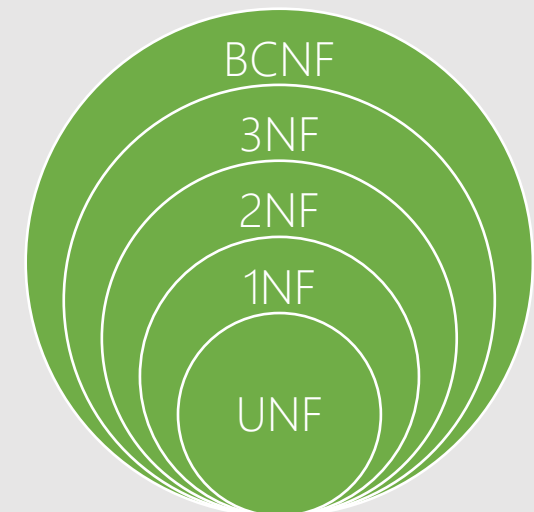
- I)  $X \rightarrow Y$  is trivial, i.e.,  $Y \subseteq X$
- II)  $X$  is a Super Key

The different between BCNF and 3NF is:

In 3NF if  $Y$  is a Candidate Key,  $X$  could be a non-key i.e., a key attribute can depend on a non-key attribute or partial key

In BCNF  $X$  must be a Super Key

i.e., a key attribute can depend only on Super Keys



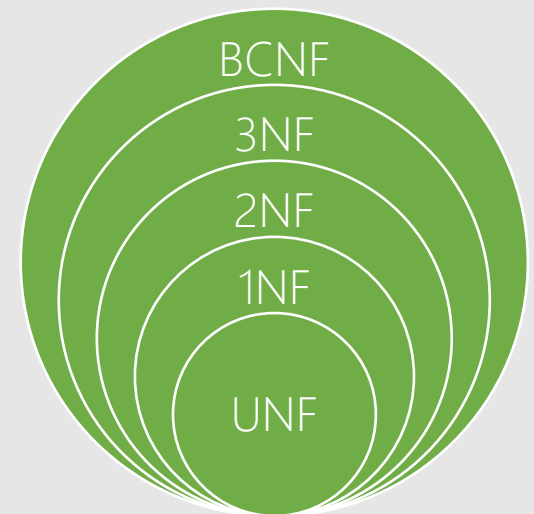
# Normalization × BCNF

E.g.  $T(A, B, C)$  with functional dependencies as  $AB \rightarrow C$  and  $C \rightarrow B$

2NF? If not, decompose  $T$  to comply with 2NF.

3NF? If not, decompose  $T$  to comply with 3NF.

BCNF? If not, decompose  $T$  to comply with BCNF.



# Normalization × BCNF

E.g.  $T(A, B, C)$  with functional dependencies as  $AB \rightarrow C$  and  $C \rightarrow B$

$\{AB\}$  is the only candidate key

$C$  is the only non-key, totally depends on the candidate key  $\rightarrow$  2NF

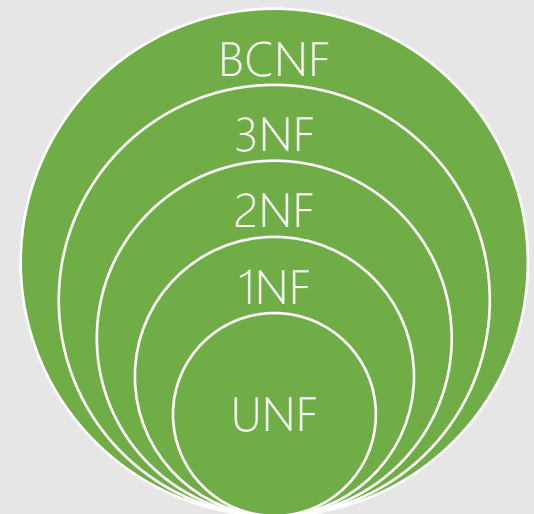
$C$  is not dependent on any other non-key  $\rightarrow$  3NF

$C \rightarrow B$  is violating BCNF since  $B$  is a key attribute but depends on  $C$  which is not a Super Key!  $C \nrightarrow A$

To make it BCNF, move  $C \rightarrow B$  to a new table, i.e.,

$T(\underline{A}, \underline{B})$

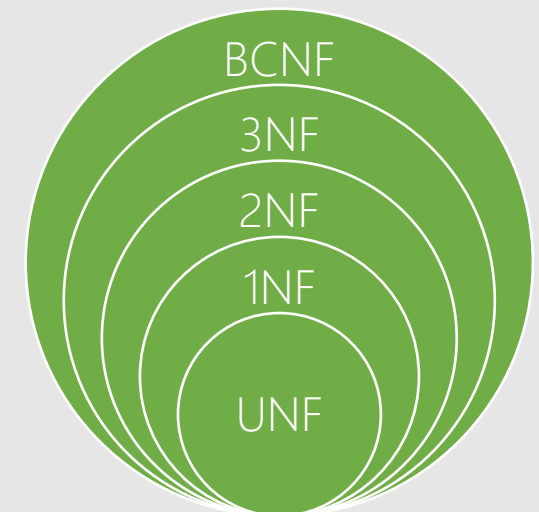
$T'(\underline{C}, B)$



# Normalization × BCNF

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Interview				
ClientNo	InterviewDay	InterviewTime	StaffNo	RoomNo
76	13	10.30	05	G101
56	13	12.00	05	G101
74	13	12.00	37	G102
56	01	10.30	05	G102





# Normalization × BCNF

Interview				
ClientNo	InterviewDay	InterviewTime	StaffNo	RoomNo
76	13	10.30	05	G101
56	13	12.00	05	G101
74	13	12.00	37	G102
56	01	10.30	05	G102

CK1: ClientNo, InterviewDay → InterviewTime, StaffNo, RoomNo

CK2: StaffNo, InterviewDay, InterviewTime → ClientNo, RoomNo

CK3: RoomNo, InterviewDay, InterviewTime → ClientNo, StaffNo

StaffNo, InterviewDay → RoomNo

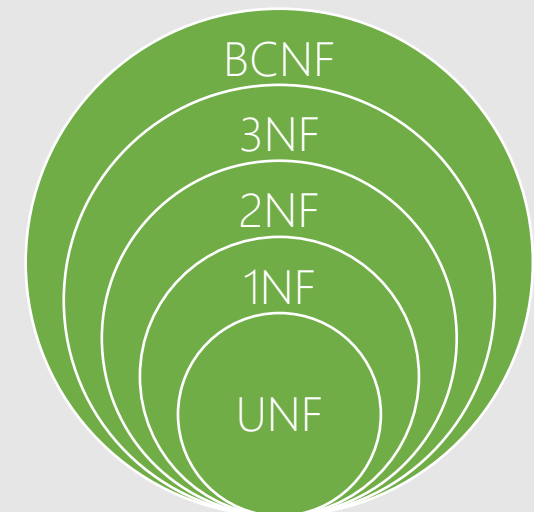
In UNF, since has a super key

In 1NF, since has no multivalued or composite attribute

In 2NF, since there is no non-key attribute

In 3NF, since there is no non-key attribute

Not in BCNF, since {StaffNo, InterviewDay} is not Super Key



# Normalization × BCNF

Interview			
ClientNo	InterviewDay	InterviewTime	StaffNo
76	13	10.30	05
56	13	12.00	05
74	13	12.00	37
56	01	10.30	05

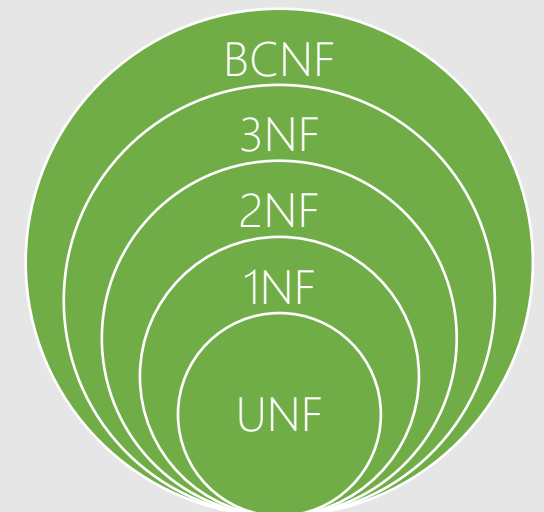
CK1: ClientNo, InterviewDay → InterviewTime, StaffNo, RoomNo

CK2: StaffNo, InterviewDay, InterviewTime → ClientNo, RoomNo

CK3: RoomNo, InterviewDay, InterviewTime → ClientNo, StaffNo

InterviewDay	StaffNo	RoomNo
13	05	G101
13	05	G101
13	37	G102
01	05	G102

StaffNo, InterviewDay → RoomNo

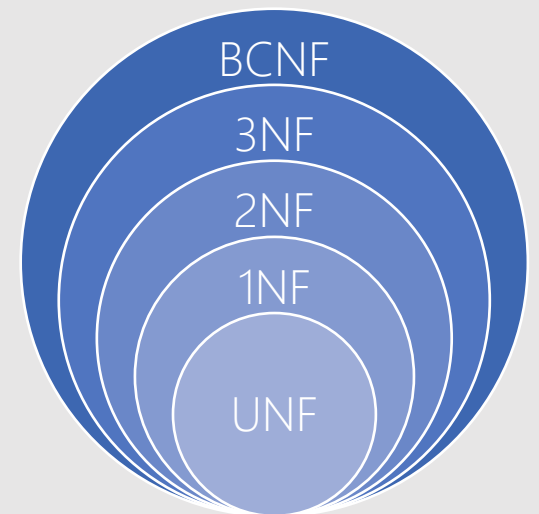


# Data Odyssey vs. Normalization

My personal view:

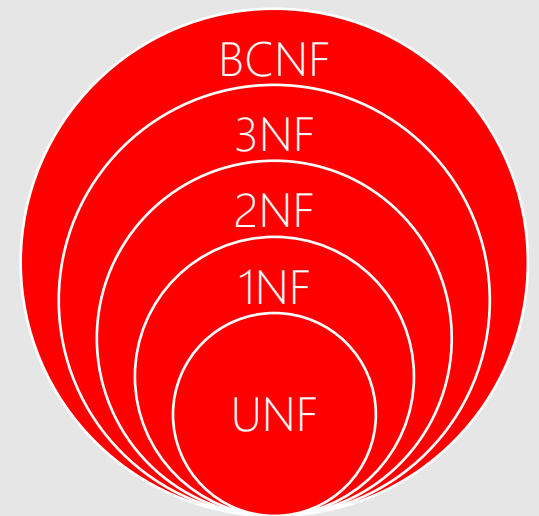
Normalization is blind to semantics, real world, ...

It's a good check but not the ultimate solution :)



# Denormalization

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