



Keys (Candidate Key, Super key and Primary Key)

Student

One or More
than one

Greater than or equal
Candidate keys

Only
One

Superkey

Enroll No	Student Name	Aadhaar No.	Address	PAN No.	Candidate No.
101	Ram	101..9	ABC	AEJO..9 8860033923	
102	Ramesh	201..8	BCD	BJ..8	
103	Surendra	301..9	EFG	CK..	
104	Kamluji	901..8	GHI	AJ..	
105	RAM	451..7	IJKL	AP..8	

(Enrollment No, Student Name)

Candidate

Enrollment No

Aadhaar No

PAN No

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07. Keys



Keys (Candidate Key, Super key and Primary Key)

Student		One or More than one	Greater than or equal Candidate keys		
Enroll No	Student Name	Aadhaar No.	Address	PAN No.	Contact No.
101	Ram	101..9	ABC	AEJO..98860033923	
102	Ramesh	201..8	BCD	BJ..8	
103	Surendra	301..9	EFG	CK..	
104	Kamluji	901..8	GHI	AJ..	
105	RAM	451..7	IJKL	AP..8	

Candidate Key

Enrollment No
Aadhaar No
PAN No

Primary Key
Alternate Key

(Enrollment No, Student Name)

Candidate



A
B
C
D
AB
AC
AD
;
ABCD

2⁴ - 1
(15)

Keys (Candidate Key, Super key and Primary Key)

R1(A, B, C, D)

① A → B, A → C
C → D

R2(A, B, D)

AB-

③ ?

AB
ABC / AC, A

A⁺ = {ABCD}

Armstrong Axioms

Reflexivity

Transitivity

Augmentation

X → Y
XZ → YZ

B⁺ = ABCD

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07. Keys



Database Normalization

Objectives of Good Database Design

- No updation, insertion and deletion anomalies
- Easily Extensible
- Good performance for all query sets
- More informative





Functional Dependency

Trivial

$$AB \rightarrow A$$

$$A \rightarrow A$$

$$ABC \rightarrow AC$$

Non-Trivial

$$A \rightarrow B$$

$$AB \rightarrow C$$

$$BC \rightarrow DEA$$

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Skip back 10 seconds (Ctrl+Left)



Database Normalization

First Normal Form

if every attribute contains
only single values. **Atomic**

Customer ID	Name	Mobile No.
101	ABC	8860033933, 9899868189
102	BCD	8960133933
103	XYZ	8681899900, 9681888800
	PQR	8189399888

X Not
in
1NF



Second Normal Form

No Partial Dependency; No non-prime Attribute should depend upon

Not in 2NF

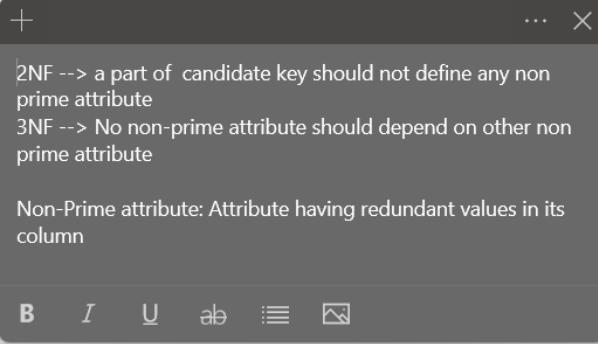
User-ID	Course-ID	Course-Fee	partial Candidate Key
1	CS101	5000	
2	CS102	2000	Cand. key
1	CS102	2000	Minimal key
3	CS101	5000	that defines
4	CS102	2000	all attributes.
2	CS103	7000	Prime Attribute

(User-ID, Course-ID)

Course-ID \rightarrow Course-Fee

Any attribute which is part of any candidate key.





Third Normal Form

① Non-Prime \rightarrow Non-Prime not allowed and
② Should be in 2NF

Alternate definitions

Def 2:

- ① In 2NF and
- ② Non prime attributes are not transitively dependent on prime attributes

Def 3

For every functional dependency

$X \rightarrow A$, one of the following should be true

- ① X is a Superkey
- ② $A - X$ is a prime attribute
- ③ $X \rightarrow A$ is a trivial functional dependency .



2NF --> a part of candidate key should not define any non prime attribute i.e. P->NP X

3NF --> No non-prime attribute should depend on other non prime attribute i.e. NP->NP X

Non-Prime attribute: not part of one of the candidate keys.

B I U ab ⏷

STUD_ID	Subject	Proj_id
1001	DBMS	103
1001	OS	110
1002	DBMS	111

BCNF Only Super keys on the left hand side

Stud_id, Subject \rightarrow Proj_id
Proj_id \rightarrow Subject

2NF
3NF
BCNF

P \rightarrow NP X
NP \rightarrow NP X
P/NP \rightarrow P X

attribute : Part of a Candidate key

2NF --> a part of candidate key should not define any non prime attribute i.e. P->NP X

3NF --> No non-prime attribute should depend on other non prime attribute i.e. NP->NP X

BCNF --> Only Super Keys on the left hand side. [X->Y: (1) Trivial OR (2)X is a SuperKey] P/NP->P X

Prime Attributes: part of the candidate key
Non-Prime attribute: not part of one of the candidate keys.

B I U ab ≡



BCNF

$X \rightarrow Y$

① Trivial OR
② X is a Superkey

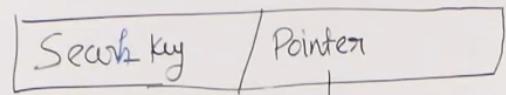
STUD_ID	Subject	Proj_id
1001	DBMS	103
1001	OS	110
1002	DBMS	111
1003	DBMS	103

Stud_id, Subject → Proj_id
Proj_id → Subject

STUD_ID	Proj_ID
1001	103
1001	110
1002	111

Proj_id	Subject
103	DBMS
110	OS
111	DBMS

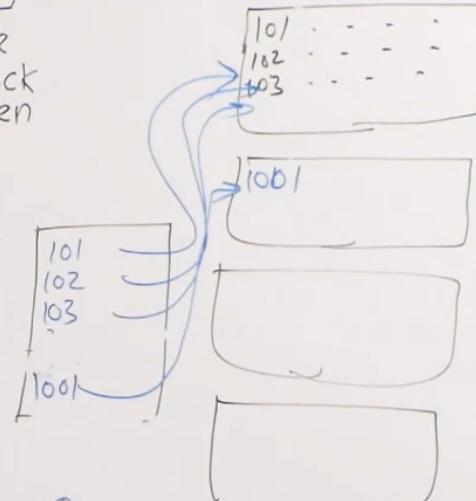
Clustered Index



Stores reference
to disk block
containing given
key

Order-ID	Order-date	Cart	Customer-ID
101	-	-	-
102	-	-	-
103	-	-	-
104	-	-	-
1001			

Disk Block



Ordered Index File

Transactions and Concurrency Control (ACID Properties)

Atomicity : Whole or Nothing

Consistency

Isolation

Durability

