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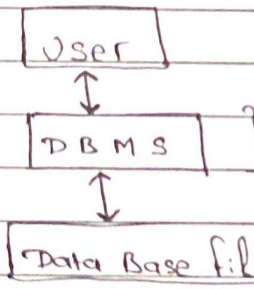
Data Base :- A data base is an organized collection of data, which is stored and accessed from a computer system.

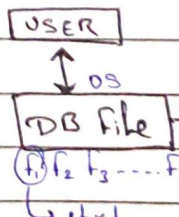
Ex: University Data Base which includes
- → Student info.
- → Faculty info.
- → Courses info.
- → classRoom info etc.

DBMS :- Software designed to define, manipulate retrieve large collection of data in a Data Base.



Flat file system [os files] :-

Data Base stores in files are manages without using DBMS Software.



⇒ DB files must manage by user.
[format of file, format of data manages by user]

⇒ Data can store in any format based on user criteria.

⇒ Suitable to manage small DB failed to manage huge DB.

# limitation of flat file System	Adv. of DBMS file system.
① Too complex to manage application Programs && Too Complex to develop application Programs	① Because of data Independency easy to develop application Program and easy to manage application Program.
② more I/O cost [access cost] to access required data from DB files.	② Because of DB indexing reduces I/O cost [access cost] to access required data from DB files]
③ less degree of concurrency. (no of user accessing dB file simultaneously)	③ More degree of concurrency.
④ Complex to manage non-redundant DB	④ Easy to maintain redundant data using normalization of DB.
⑤ Difficult to implement different level of access control.	⑤ By using Views [virtual tables] easy to implement different levels of access control.

Data Model :- Data model define how the logical structure of a DB is modeled

Data models.

⇒ Relational Data Models → widely used
⇒ object oriented data models
⇒ Hierarchical data model.
⇒ Network data model.

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RDBMS :-

- Proposed by E.f. codd
- Also called codd's data model
- Codd. Proposed 12 rules to design RDBMS s/w [also called RDBMS Guidlines]

Relational DBMS [RDBMS] :- s/w which is used to store data which need to be stored in the tabular form.

[Data managed and stored in row's and column's]

Example Student Relation.

Stud (Table name)

Sid	Sname	age
501	A	20
502	B	20
503	C	25
504	A	20
505	C	22

Sid, Sname, age → Attribute / Field

501 A 20 → Tuple / record

Relational Instance / Snapshot [Record set]

5! x 5! ways

Relational Schema : definition of the table

Stud (Sid, Sname, age)

Relational instance [or snapshot] : set of Records of the table

Arity : [degree] no of attributes of the table

Cardinality :- no. of record of the table

No two Records of the RDBMS table is same
[RDBMS Guideline]
Every RDBMS table must have atleast one Candidate Key.

candidate Key :- Minimal attribute set which can differenciate records of relation uniquely.

Ex1 Stud (Sid Sname age) {Sid} : cand key

S1	A	20
S2	A	20
S3	B	22
S4	B	20

{Sid Sname} Not Candidate Key.

Ex2 Enroll {Sid Cid fee}

S1	C1	-
S1	C2	-
S2	C2	-
S2	C3	-

constraint : Student can enroll many courses and course can be enroll by many student

Primary key(Sid, Cid)

Candidate key Sid Cid.

Ex3 R

A	B	C
4	6	3
4	8	3
4	6	4
4	8	4
6	6	3

Cand. key :- ABC

Relation can have many candidate keys.

Assume no two EMP's with same IFSC code & ACC no.

Emp {made Easy} emp

Eid	Ename	DOB	PANID	AdharID	IFSC Code	ACC
e1	R	1985	X5		SBI01	101
e2	R	1985	NULL		CAN01	101
e3	R	NULL	X8		SBI01	102
e4	A	NULL	X2		CAN01	102
e5	B	1980	NULL		SBI02	103
e6	B	1982	X3		HDFC	103

Candidate Keys :

{(eId), (PanId, adharID, IFSC ACC)}

eId → Primary Key [No NULL]

(PanId, adharID, IFSC ACC) → alternative keys [NULL allowed]

NULL : unknown or unexisted value

Diff. b/w

Primary Key	Alternative Keys
* Any one candidate key whose field values not allowed 'NULL'	* All candidate keys of relation except Primary Key
* Field values Not Null	* field values can be NULL's
* At most one Primary key allowed for any relation.	* Many alternative key allowed.

schema definition :-

Emp (Eid, Ename, DoB, PANID, AdharID, IFSC ACC)

```
CREATE TABLE Emp
( eid varchar(10) PRIMARY KEY
  ename varchar(20) NOT NULL,
  DoB date,
  PanId varchar(6) UNIQUE,
  adharId integer(12) UNIQUE NOT NULL,
  IFSC varchar(8),
  acc integer(10),
  UNIQUE(ifsc, acc)
);
```

text } variable length.
data type

{ PRIMARY KEY ≠ UNIQUE NOT NULL }

Simple candidate key :- Candidate key with only one attribute.

composite candidate key :- Candidate key with atleast two attribute

Prime attribute :- Attribute which belongs to some Candidate key of Relation.

Emp(Eid. Ename DoB PanId AdharId. Ifsc Acc)

* Candidate keys {Eid, PanId, AdharId, Ifsc Acc no}
* Simple candidate keys : {Eid, PanId, adharId}
* composite candidate keys : {Ifsc Acc}
* Prime Attribute set of emp : {Eid, PanId adharId Ifsc acc}
* Non prime Attribute set of emp : {ename, DoB}

Every RDBMS relation there must be atleast one candidate key whose field values NOT NULL.

Primary key not mandatory for RDBMS relation (At most one PK)

R(A B C) {A, B} candkeys

a_1	b_4	c_1
a_2	null	c_1
a_3	b_2	c_1
a_4	null	c_2

CK with no null

Preferred

No PK

```
CREATE TABLE R
( A varchar(3) UNIQUE NOT NULL,
  B varchar(3) UNIQUE,
  C varchar(3)
);
```

One PK

```
CREATE TABLE R
( A varchar(3) Primary key,
  B varchar(3) UNIQUE,
  C varchar(3)
);
```

01:38:00 **Super key** :- Set of attributes which can differentiate record of relation uniquely [may not minimal Attribute set]

⇒ candidate key : Minimal Super key.

⇒ Every Candidate key is Super key
Not every Super key is candidate key

Set of candidate keys of Relation(R)

Set of Super keys of Relation (R)

Student (Sid Sname age) candidate key : Sid
Super keys : { Sid,
Sid Sname,
Sid Sage,
Sid Sname age }

① How many Super keys in relation R (A, B, C, D) with candidate key {A}.

R (A B C D)
any subset of B, C, D
2^3

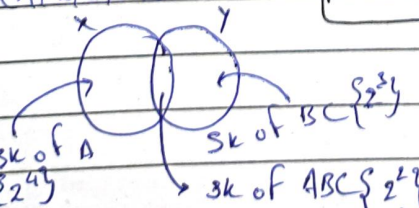
Super keys : { A, AB, ABC, ABCD, AC, ABD, AD, ACD. }

SK = 8

② How many Super keys in relation R(A, B, C, D, E) with
(i) candidate key {A, BC} (ii) Candidate keys : {AB, BC}

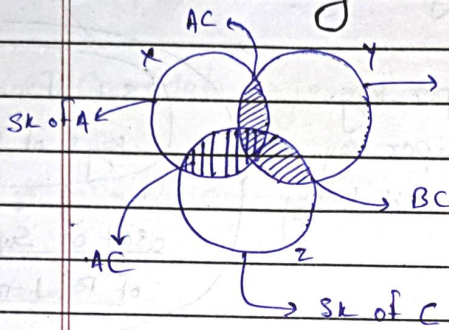
i) R(A, B, C, D, E)

$$n(x \cup y) = n(x) + n(y) - n(x \cap y)$$
$$= 16 + 8 - 4$$
$$= 20 \text{ SK's}$$



Similary, 12 SK for II

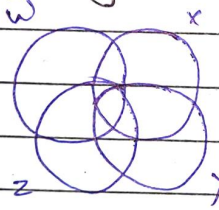
3. How many super keys in relation R(A,B,C,D,E,F)
(i) Candidate key {A, B, C} (ii) Cand. key {A, BC, CD}



$n(x \cup y \cup z) =$
$n(x) + n(y) + n(z)$
$- n(x \cap y) - n(x \cap z) - n(y \cap z)$
$+ n(x \cap y \cap z)$
$= 2^5 + 2^5 + 2^5 - 2^4 - 2^4 - 2^4 + 2^3$
$= 56$

Similarly (II)
$2^5 + 2^4 + 2^4 - 2^3 - 2^3 - 2^3 + 2^2 = 44$ Super Keys.

4. How many super keys in relation R(A,B,C,D,E) with candidate key {AB, BC, CD, DE}.



AB	BC	CD	DE
ABC	BCD	ACD	ADE
ABD	BCE	CDE	BDE
ABE	BCDE	ACDE	
ABCD			
ABCE			
ABDE			
ABCDE			

19 SK

$n(w \cup x \cup y \cup z) =$
$n(w) + n(x) + n(y) + n(z)$
$- n(w \cap x) - n(w \cap y) - n(w \cap z) - n(x \cap y) - n(x \cap z) - n(y \cap z)$
$+ n(w \cap x \cap y) + n(w \cap x \cap z) + n(w \cap y \cap z) + n(x \cap y \cap z)$
$- n(w \cap x \cap y \cap z).$

5. $R(A_1\ A_2\ A_3\ A_4 \ldots\ A_n)$ How many super keys possible in relation.

If (i) $\{A_1\}$ candidate key $\longrightarrow$ 2^{n-1} SK

(ii) $\{A_1A_2, A_2A_3\}$ cand. keys. $\longrightarrow$ $2^{n-2}+2^{n-2}-2^{n-3} \Rightarrow 3*2^{n-3}$ SK

(iii) $\{A_1, A_2, A_3\}$ cand. keys. $\longrightarrow$ $7 * 2^{n-3}$

(iv) $\{A_1A_2, A_3A_4, A_4A_5A_6\}$ cand. keys. $\longrightarrow$ $2^{n-2}+2^{n-2}+2^{n-3}-2^{n-4}-2^{n-4}-2^{n-5}+2^{n-6}$

6. $R(A_1A_2A_3 \ldots A_n)$ How many possible SK in R?

a) $n!$ b) 2^{2^n} c) 2^n-1 d) 2^n

R(ABC)

SK : {A
B
C $2^3-1=7$
AB
BC
AC
ABC
}

Max Possible SK's
if each no. of R is CK
CK's = $\{A_1, A_2 \ldots A_n\}$
2^n-1 SK.

$R(A_1\ A_2 \ldots A_n)$
min. no of SK's in R: 1

7 $R(A\ B\ C\ D\ E)$ How many Maximum candidate keys Possible

R(ABCDE)

$^5C_1$	$^5C_2$ ✓	$^5C_3$ ✓	$^5C_4$	$^5C_5$
= 5	= 10	= 10	= 5	= 1
A	AB	ABC	ABCD	ADCDE
B	AC	ABD	ABCE	
C	AD	:	:	
D	:	:	:	
E	:	:	:	

$^5C_2$ or $^5C_3$ only one group can be candidate key at a time

8. $R(A_1 A_2 A_3 \dots A_n)$ How many maximum Possible candidate Keys in Relation R?

Ans. ${}^{n}C_{n/2}$ or ${}^{n}C_{\frac{n+1}{2}}$, ${}^{n}C_{\frac{n-1}{2}}$

9. $R(A_1 A_2 A_3 \dots A_n)$ How many Possible sk. if m simple candidate Keys? $m < n$.

no. of sk's of rel R = { no. of sk's among Prime Attr of Rel R } * $2^{\text{no. of non prime Attr of R}}$

$R(\underbrace{A_1, A_2, A_3 \dots A_m}_{\text{m simple ck's}}, \underbrace{A_{m+1} \dots A_n}_{\text{n-m non Prime Attr}})$

no. of sk's among m simple ck's $(2^m - 1)$

no. of sk's of rel R $= (2^m - 1) * 2^{n-m}$

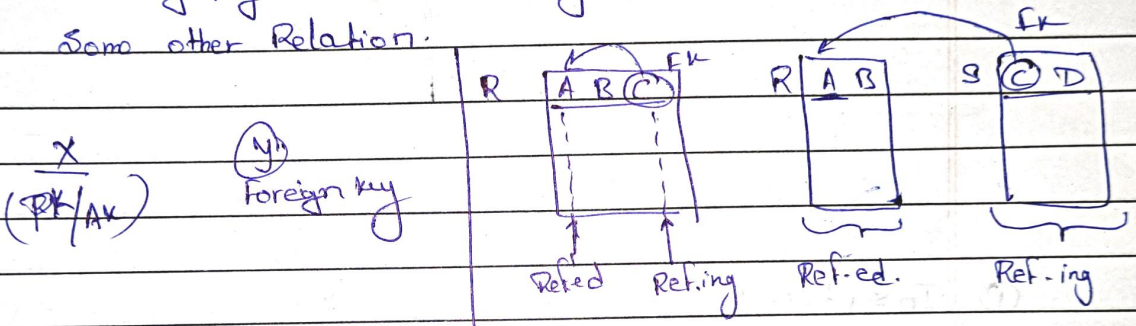
Foreign Key [referencial key]

⇒ used to relate data [Relationship set]

⇒ Defined over two relations.

① Referenced Relation ② Referencing relation.

⇒ Definition :- foreign key is set of attributes references Primary key or Alternative key of same relation or some other Relation.



Referencial key Integrity constraints :-

i) Referenced Relation

Stud

Sid	Sname	DoB
S_1		2000
S_2		2002
S_3		2002
S_4		2000
S_5		2005

ii) Referencing Relation.

Enroll

Sid (FK)	cid	Fee
S_1	C_1	5000
S_1	C_2	4000
S_2	C_2	5000
S_2	C_3	4000
S_5	C_1	6000
~~S_{12}~~	~~C_1~~	~~5000~~ - restricted

Primary key 'Sid Cid'

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① Insertion :- No violation to the Fk.

② Deletion :- May cause violation to the Fk

(default) i) on Delete no Action — Deletion of Referenced Record not allowed. if Fk violation occurs.

ii) on deletion cascade - Deletion of Referenced record is allowed, if DBMS delete all related referencing records.

iii) on delete set Null - if Fk attribute allowed set Null then allowed to delete referenced record & set Null in reffered fk value

Insertion :- May cause violation to the Fk

② Deletion :-
No violation to the Fk

③ Updation: May cause violation to the FK.

(default) (i) on update NO Action
(ii) on update cascade
(iii) on update SET NULL

Stud (Sid. Sname DoB)
Referenced rel

```
CREATE TABLE Stud
( Sid varchar(10) PRIMARY KEY,
 Sname varchar(20),
 DoB date.
);
```

Updation:
May cause fk violation.

[Updation / Insertion] of refencing rel restricted if fk violation occurs]

Enroll (Sid Cid fee)
Referencing rel

```
CREATE TABLE Enroll
( Sid varchar(10),
  Cid varchar(10),
  fee Integer(5)
  PRIMARY KEY (Sid, Cid)
FOREIGN KEY (Sid) REFERENCES Stud(Sid)
  ON DELETE CASCADE
  ON UPDATE CASCADE
);
```

Integrity constraint.

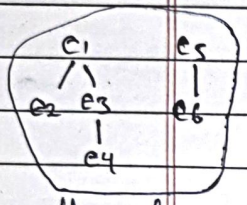
NOTE :-

① Foreign Key can references Primary Key / alternative Key of same relation.

PK FK

EMP	eid	Ename	SupID
	e1	A	NULL
	e2	B	e1
	e3	C	e1
	e4	B	e3
	e5	C	NULL
	e6	E	e5.

(SupID is also employee.)



all employee of same company

⇒ If Fk SupID is on delete no action Then deletion of record whose eid = e1 is Not allowed to delete record ~~eid = e1~~

⇒ If fk is on delete cascade then How man additional records forced to delete in-order to delete record whose eid = e1 ?

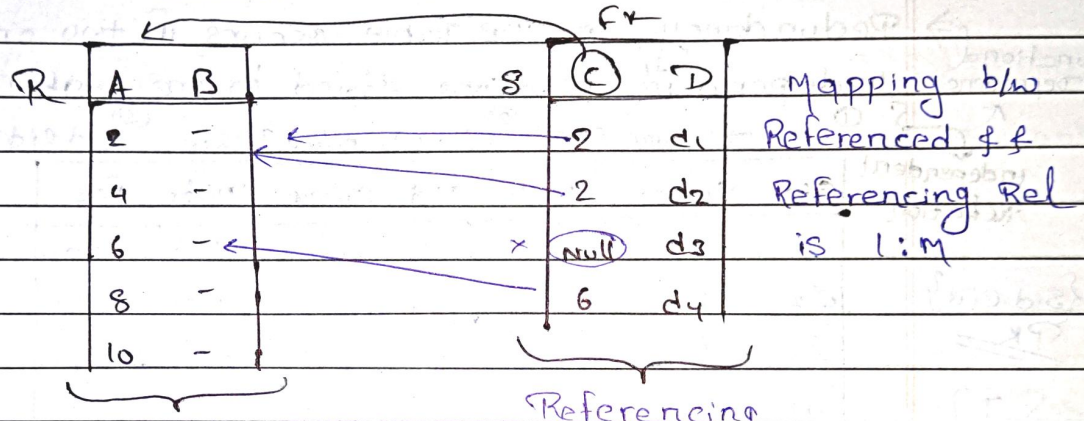
→ Ans 3.

⇒ If fk is on delete set NULL then How many additional records forcad to delete in-order to delete record whose eid = e1. ?

→ None

② foreign key allowed Null values.

* Referencing relation records whose foreign key field value's null are out of referencial constraint (Not related to referenced records)



Referencing relation.

Referenced Relation	Referencing relation.
Each record of referenced Relation relates to many (0 or more) records of referencing relation.	Each record of referencing relation related by atmost one (0 or 1) records of Referenced relation.