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Database Management System :

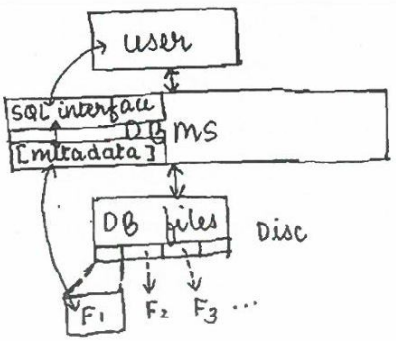
1. Integrity constraints and ER Model 1-2 marks
2. Normalization 2-4 marks
3. Queries (relational algebra, SQL, relational calculus) 4 marks
4. File organization and Indexing (B / B+ Tree) 2-4 marks
5. Transactions and concurrency control. 2-4 marks

Reference Books -

1) DBMS - Raghuramakrishnan
2) DBMS - Navathe

→ Introduction :

- Database - structured collection of related data which is stored in computer system to access data when it is required.
- University DB students info, faculty info, course info etc. [collection of files]
- Database management system - application software to define, manipulate and access data from database.



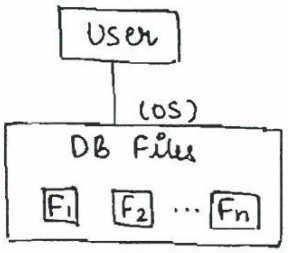
} Interface b/w user and DB files

- metadata - data about data
  - also called data dictionary
  - Format of file
  - Format of row and column
  - All storage info related to DB files

- Flat file System [OS files] - user manage database files without using DBMS.

- Small database is managed.

  Flat file system fails to manage huge DB.



OS Files : · txt
·csv

Limitations of Flat File System	Adv. of DBMS File System
i) Too complex to manage app^n programs. Complete info of the program should be managed by user. (·DBA ·DB developer ·end user)	i) Easy to develop app^n programs because of data independency: (changes of file structure is not affecting for user app^n, user can use db files without knowing storage info)
ii) more I/O cost (and access cost) to access required data from db files	ii) less I/O to access required data from db files from using indexing.
iii) less degree of concurrency	iii) more degree of concurrency
iv) Too complex to maintain non-redundant data	iv) easy to maintain non-redundant data by using normalization.
v) Too complex to maintain different levels of access control.	v) By using views (virtual tables) can maintain different levels of access control.

→ Integrity constraints : based on RDBMS model

→ correctness of data

- Data model - logical structure of DB files
  - → RDBMS (in syllabus) : · is widely used
  - → ODBMS · Codd's data model (By EF codd)
  - → NWDBMS · Codd proposed 12 rules to design RDBMS software. (RDBMS guidelines)
  - → Hierarchical DBMS

- RDBMS Guidelines -

i) data in db files must be in tabular format. (set of rows & cols)

ii) no two rows of the table should be same.

iii) Every RDBMS table must have atleast one candidate key.

iv) Every attribute of RDBMS table must be singe valued (atomic)

Eg :

Sid	Sname	Cid ← multivalued attribute not allowed in RDBMS
S_1	A	$\{C_1, C_2\}$
S_2	B	$\{C_2, C_3\}$

v) Number of columns for each row and no. of rows for each col. must be same

vi) Name of one column is called attribute (or field)

vii) Name of one row is called record or Tuple

viii) Set of all records of the table is called relational instance (or snapshot)

Stud

Sid	Sname	DOB
S_1	A	2000
S_2	B	2000
S_3	C	2002
S_4	D	2004

Attribute field

Tuple

relational instance

: Set of all records of DB Table

cardinality : 4

arity : 3

- Relational schema - definition of table

  Eg: Stud(sid, sname, DOB)

- Arity - number of attributes of the table
- Cardinality - number of records of the table
- domain of attribute - set of possible values accepted by the attribute.
- data type -
  - char(10)
  - varchar(20)
  - Integer(10)
  - text (for long text / para)
  - Boolean
  - Date (excluding time) DD/MM/YYYY
  - Timestamp (including time)

- Candidate Key - minimal set of attributes to differentiate records of the relation uniquely.

  E.g.) [Sid] : CK ✓

  [Sid, Sname] : not CK as it is not minimal

- Let [A B] be a candidate key
  - Then A B is unique for all records
  - no proper subset attributes of {A, B} can differentiate records uniquely.

- " student can enroll many courses"

  " Course can be enrolled by many students"

Sid	cid	fee
S1	C1	–
S1	C2	–
S2	C2	–
S4	C2	–

cand Key [Sid, cid]

NOTE:

NULL - unknown value or nonexisting value

Emp

eid	ename	DOB	panID	IFSC	A.no	Acc
e1	A	2000	X5	SBI01		101
e2	B	NULL	NULL	SBI01		102
e3	C	2005	NULL	ICIC101		101
e4	D	NULL	X2	ICIC01		102

Primary Key	Alternate Key
i) Anyone cand key of RDBMS table whose field values are not allowed to have NULL	i) All cand keys of the table except primary key whose field values are allowed to have NULL
ii) Every attribute of p.k is not allowed NULLs	ii) NULL allowed
iii) Atmost one primary key is allowed in any RDBMS table	iii) Many alternative keys are allowed

SYNTAX for create table :

```
CREATE TABLE Emp
(eid varchar(10) Primary Key,        → unique and not NULL
ename varchar(20) NOT NULL,          → duplicate values allowed but can be left NULL
DOB date,
panID varchar(8) UNIQUE,             → NULL allowed but fields must be unique
adharID integer(12) UNIQUE NOT NULL,
IFSC varchar(6),
Acc integer(10),
UNIQUE (IFSC, Acc)
);
```

* check : Range of attr in fixed value
- used in create table
- age int(2) check between 15 to 30

candidate keys { eid, panID, adharID, IFSC, Acc }

eid → Primary key

panID, adharID, IFSC, Acc → alternate keys

- Simple candidate key - candidate key with only one attribute. {eid}
- Composite candidate key - cand. key with atleast two attributes {IFSC, Acc}

- Prime attribute - attribute which belongs to some candidate key of the relation.
- Emp(eid, ename, DOB, panID, adharID, IFSC, Acc)
- cand key { eid, panID, adharID, IFSC Acc}
- Thus {eid, ename, panID, adharID, IFSC, Acc} are prime attributes

- prime attribute set - { eid, panID, adhar, IFSC, Acc} of emp
- Non-prime attributes - attributes which does not belong to any key of the relation.
- Non-prime attribute set - { ename, DOB} of emp

* Atleast one candidate key whose field values must be NOT NULL (in RDBMS)

```
Creati table R
(   A   integer(3)   NOT NULL UNIQUE,
    B   integer(3)   UNIQUE,
    C   integer(3)
);
```

```
creati table R
(   A   integer(3)   primary key,
    B   integer(3)   UNIQUE,
    C   integer(3)
);
```

* UNIQUE NOT NULL ≠ Primary Key
  default index
  default ordering

- SuperKey - attribute set which can differentiate the records of relation uniquely (but may not be minimal attribute set)

Stud(Sid,	sname,	DOB)
S1	A	2000
S2	A	2000
S3	B	2005
S4	B	2005

cand key { Sid} : minimal superkey

Superkeys { Sid,
  sid sname,
  sid DOB,
  sid sname DOB

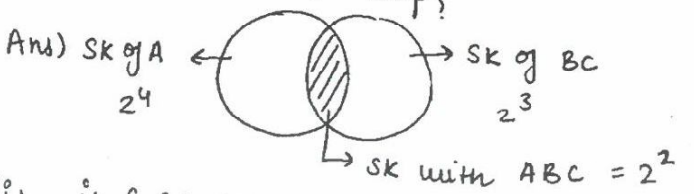
Qus) R(A B C D) How many superkeys in R with cand key {A}?

ans) A . { any subset of BCD } => A . |{ Sub of BCD }|

=> A . 2^3

Thus, 8 superkeys are there with cand key {A}

Qus) R(A B C D E) How many SK's in R (i) if {A, BC} are the cand key?

Ans) 

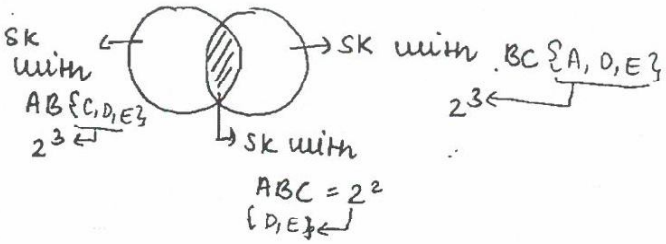
Total superkeys $n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$

$= 2^4 + 2^3 - 2^2$

$= 16 + 8 - 4$

= 20 superkeys

ii) if {AB, BC} are the cand key?



Total superkeys =

$= 2^3 + 2^3 - 2^2$

$= 8 + 8 - 4$

= 12 superkeys

Method 2 :

$$\#\text{ of superkeys of R} = \left\{ \begin{matrix} \#\text{ of superkeys} \\ \text{among prime} \\ \text{attr of R} \end{matrix} \right\} * 2^{\{\#\text{ of non prime attributes}\}}$$

i) {A, BC}

$$\#\text{ of superkeys} = \left\{ \begin{matrix} A, ABC \\ AB, BC \\ AC \end{matrix} \right\} * 2^{\{D,E\}} = 5 * 2^2$$

= 20 superkeys

here prime attributes = A, B, C

& non prime attributes = D, E

ii) {AB, BC}

$$\#\text{ of superkeys} = \left\{ \begin{matrix} ABC, BC \\ AB \end{matrix} \right\} * 2^{\{D,E\}} = 3 * 2^2$$

= 12 superkeys

Ques) if cand Key are {A, B, C}

(i) Then how many SK's in relation R (A, B, C, D, E, F)

$$\#\text{ of SK's} = \{ A \quad B \quad C \quad AB \quad BC \quad AC \quad ABC \} * 2^{\{D,E,F\}}$$

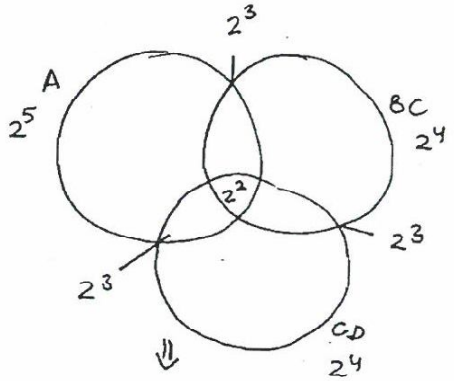
$$= 7 * 2^3 = 56 \text{ Superkeys}$$

ii) {A, BC, CD} are the cand Keys?

$$\#\text{ of SK's} = \{ A \quad BC \quad AB \quad BCD \quad AC \quad CD \quad AD \quad ABC \quad ABD \quad ACD \quad ABCD \} * 2^{\{E,F\}}$$

$$= 11 * 4$$

$= 44$ superkeys



$$= 2^5 + 2^4 + 2^4 - \{2^3 + 2^3 + 2^3\} + 2^2 \quad <= \quad n(A) + n(BC) + n(CD) - \{n(ABC) + n(BCD) + n(ACD)\} + n(ABCD)$$

$= 32 + 16 + 16 - 8 - 8 - 8 + 4$

$= 44$ superkeys

Ques) $R(A_1\ A_2 \ldots A_n)$ How many superkeys in relation R if (Assume total attributes are >= 6)

i) $\{A_1, A_2A_3, A_3A_4\}$ cand Keys

i) $\{A_1A_2, A_2A_3A_4, A_3A_4A_5A_6\}$ Cand Keys

) $\{A_1, A_2A_3, A_3A_4\}$

Prime att : $A_1\ A_2\ A_3\ A_4$ $\quad \#\text{ of Sk} = 11 * 2^{n-4}$

$\{A_1\} * 2^3$

$+ \{A_2A_3\} * 2^1$

$+ \{A_3A_4\} * 2^0$

$= 8 + 2 + 1 = 11$