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## Last Minute Notes – DBMS

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We will discuss the important key points useful for GATE exams in summarized form. For details you may refer [this](#).

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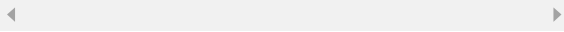
**E-R Diagram:** The most common asked questions in ER diagram is minimum number of tables required for a given ER diagram. Generally, following criteria are used:

Cardinality	Minimum No. of tables
1:1 cardinality with partial participation of both entities	2

1:1 cardinality with 1  
total participation of  
atleast 1 entity

1:n cardinality 2

m:n cardinality 3



**Note:** This is a general observation. Special cases need to be taken care. We may need extra table if attribute of a relationship can't be moved to any entity side.

**Keys of a relation:** There are various types of keys in a relation which are:

- **Candidate Key:** The minimal set of attributes which can determine a tuple uniquely. There can be more than 1 candidate key of a relation and its proper subset can't determine tuple uniquely and it can't be NULL.
- **Super Key:** The set of attributes which can determine a tuple uniquely. A candidate key is always a super key but vice versa is not true.
- **Primary Key and Alternate Key:** Among various candidate keys, one key is taken primary key and others are alternate keys.
- **Foreign Key:** Foreign Key is a set of attributes in a table which is used to refer the primary key or alternative key of the same or other table.

### Normal Forms

- **First Normal Form:** A relation is in first normal form if it does not contain any multi-valued or composite attribute.
- **Second Normal Form:** A relation is in second normal form if it does not contain any partial dependency. A dependency is called partial dependency if any proper subset of candidate key determines non-prime (which are not part of candidate key) attribute.
- **Third Normal Form:** A relation is in third normal form if it does not contain any transitive dependency.

For a relation to be in Third Normal Form, either LHS of FD should be super key or RHS should be prime attribute.

- **Boyce-Codd Normal Form:** A relation is in Boyce-Codd Normal Form if LHS of every FD is super key.  
The relationship between Normal Forms can be represented as: **1NF  $\supset$  2NF  $\supset$  3NF  $\supset$  BCNF**

**Relational Algebra:** Procedural language with basic and extended operators.

### Basic Operator

### Semantic

$\sigma$ (Selection)	Select rows based on given condition
$\Pi$ (Projection)	Project some columns
<b>X (Cross Product)</b>	Cross product of relations, returns <b>m*n</b> rows where m and n are number of rows in R1 and R2 respectively.
<b>U (Union)</b>	Return those tuples which are either in R1 or in R2. Max no. of rows returned = <b>m+n</b> and Min no. of rows returned = <b>max(m,n)</b>
<b>-(Minus)</b>	R1-R2 returns those tuples which are in R1 but not in R2. Max no. of rows returned = <b>m</b> and Min no. of rows returned = <b>m-n</b>
$\rho$ (Rename)	Renaming a relation to other relation.



## Extended Operator

### Semantic


$\cap$ <b>(Intersection)</b>	Returns those tuples which are in both R1 and R2. Max no. of rows returned = $\min(m,n)$ and Min no. of rows returned = 0
$\bowtie_c$ <b>(Conditional Join)</b>	Selection from two or more tables based on some condition (Cross product followed by selection)
$\bowtie$ <b>(Equi Join)</b>	It is a special case of conditional join when only equality condition is applied between attributes.
$\bowtie$ <b>(Natural Join)</b>	In natural join, equality condition on common attributes hold and duplicate attributes are removed by default. <b>Note:</b> Natural Join is equivalent to cross product if two relations have no attribute in common and natural join of a relation R with itself will return R only.
$\bowtie\leftarrow$ <b>(Left Outer Join)</b>	When applying join on two relations R and S, some tuples of R or S does not appear in result set which does not satisfy the join conditions. But Left Outer Joins gives all tuples of R in the result set. The tuples of R which do not satisfy join condition will have values as NULL for attributes of S.
$\bowtie\rightarrow$ <b>(Right Outer Join)</b>	When applying join on two relations R and S, some tuples of R or S does not appear in result set which does not satisfy the join conditions. But Right Outer Joins gives all tuples of S in the result set. The tuples of S which do not satisfy join condition will have values as NULL for attributes of R.
$\bowtie\leftarrow\rightarrow$ <b>(Full Outer Join)</b>	When applying join on two relations R and S, some tuples of R or S does not appear in result set which does not satisfy the join conditions. But Full Outer Joins gives all tuples of S and all tuples of R in the result set. The tuples of S which do not satisfy join condition will have values as NULL for attributes of R and vice versa.
$\div$ <b>(Division Operator)</b>	Division operator A/B will return those tuples in A which is associated with every tuple of B. <b>Note:</b> Attributes of B should be proper subset of attributes of A. The attributes in A/B will be Attributes of A- Attribute of B.



[How to solve Relational Algebra problems for GATE – SET 1](#)

[How to solve Relational Algebra problems for GATE – SET 2](#)

**SQL:** As opposed to Relational Algebra, SQL is a non-procedural language.

Operator	Meaning
<a href="#"><u>Select</u></a>	Selects columns from a relation or set of relations. <b>Note:</b> As opposed to Relational Algebra, it may give duplicate tuples for repeated value of an attribute.
<a href="#"><u>From</u></a>	<b>From</b> is used to give input as relation or set of relations from which data needs to be selected.
<a href="#"><u>where</u></a>	<b>Where</b> is used to give condition to be used to filter tuples
<a href="#"><u>EXISTS</u></a>	<b>EXISTS</b> is used to check whether the result of a correlated nested query is empty (contains no tuples) or not.
<a href="#"><u>Group By</u></a>	<b>Group By</b> is used to group the tuples based on some attribute or set of attributes like counting the no. of students group by department.
<a href="#"><u>Order By</u></a>	<b>Order By</b> is used to sort the fetched data in either ascending or descending according to one or more columns.
 <a href="#"><u>Aggregate functions</u></a>	Find the aggregated value of an attribute. Used mostly with group by. e.g.; count, sum, min max. <b>select count(*) from student group by</b>

**dept\_id**Note: we can select only those columns which are part of group by.

### Nested Queries

When one query is a part of other query. Solving nested queries questions can be learnt in

**<https://www.geeksforgeeks.org/nested-queries-in-sql/>**



**Conflict serializable and Conflict Equivalent:** A schedule is conflict serializable if it is conflict equivalent to a serial schedule.

### **Checking for Conflict Serializability**

To check whether a schedule is conflict serializable or not, find all **conflicting operations pairs** of a schedule and draw precedence graph ( For all conflicting operation pair, an edge from  $T_i$  to  $T_j$  if one operation of conflicting pair is from  $T_i$  and other from  $T_j$  and operation of  $T_i$  occurs before  $T_j$  in schedule). If graph does not contain cycle, the schedule is conflict serializable else it is not conflict serializable.

Schedules are said to be conflict equivalent if 1 schedule can be converted into another by swapping non conflicting operations.

**Note:** Two phase locking protocol produce conflict serializable schedule but may suffer from deadlock. On the other hand, Time-Stamp based protocols are free from deadlock yet produce conflict serializable schedule.

**View Serializable and View Equivalence :** Two schedules  $S_1$  and  $S_2$  are said to be view-equivalent if all conditions are satisfied for all objects:

- If the transaction  $T_i$  in  $S_1$  reads an initial value for object  $X$ , in  $S_2$  also,  $T_i$  must read the initial value of  $X$ .
- If the transaction  $T_i$  in  $S_1$  reads the value written by transaction  $T_j$  in  $S_1$  for object  $X$ , same should be done in  $S_2$ .



If the transaction  $T_i$  in  $S_1$  is the final transaction to write the value for an object  $X$ , in  $S_2$  also,  $T_i$  must write the final value of  $X$ .

A schedule is view serializable if it is view equivalent to any serial schedule.

**Irrecoverable Schedules:** For a transaction pair  $\langle T_i, T_j \rangle$ , if  $T_j$  is reading the value updated by  $T_i$  and  $T_j$  is committed before commit of  $T_i$ , the schedule will be irrecoverable.

**Recoverable Schedules:** For a transaction pair  $\langle T_i, T_j \rangle$ , if  $T_j$  is reading the value updated by  $T_i$  and  $T_j$  is committed after commit of  $T_i$ , the schedule will be recoverable.

**Cascadeless Recoverable Schedules:** For a transaction pair  $\langle T_i, T_j \rangle$ , if value updated by  $T_i$  is read by  $T_j$  only after commit of  $T_i$ , the schedule will be cascadeless recoverable.

**Strict Recoverable:** For a transaction pair  $\langle T_i, T_j \rangle$ , if value updated by  $T_i$  is read or written by  $T_j$  only after commit of  $T_i$ , the schedule will be strict recoverable. The relationship between them can be represented as:

**Strict  $\subset$  Cascadeless Recoverable  $\subset$  recoverable  $\subset$  all schedules**

#### File structures

**Primary Index ::** A primary index is an ordered file, records of fixed length with two fields. First field is same as primary key as data file and second field is a pointer to data block, where the key is available.

The average number of block accesses using index =  **$\log_2 B_i + 1$** , where  $B_i$  = number of index blocks.

**Clustering Index :** Clustering index is created on data file whose records are physically ordered on a non-key field (called Clustering field).



**Secondary Index :** Secondary index provides secondary means of accessing a file for which primary access already exists.

Number of index entries = Number of records

### **B Trees**

At every level , we have Key and Data Pointer and data pointer points to either block or record.

### **Properties of B-Trees :**

Root of B-tree can have children between **2** and **P**, where P is Order of tree.

**Order of tree** – Maximum number of children a node can have.

Internal node can have children between  $\lceil P/2 \rceil$  and **P**

Internal node can have keys between  $\lceil P/2 \rceil - 1$  and **P-1**

### **B+ Trees**

In B+ trees structure of leaf and non-leaf are different, so their order is. Order of non-leaf will be higher as compared to leaf nodes.

Searching time will be less in B+ trees, since it doesn't have record pointers in non-leaf because of which depth will decrease.

This article has been contributed by Sonal Tuteja.

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