**CS223 – Database Management Systems**

**Short Answer Questions**

**SET - 1**

1. Define data and information.

Data is a raw and unorganized fact that required to be processed to make it meaningful. Information is a set of data which is processed in a meaningful way according to the given requirement. Information is processed, structured, or presented in a given context to make it meaningful and useful.

1. Define DBMS.

A database management system (DBMS) is a software package designed to define, manipulate, retrieve and manage data in a database.

1. What is data independence?

Data independence refers characteristic of being able to modify the schema at one level of the database system without altering the schema at the next higher level. There are two types of data independence: Logical Data Independence and Physical Data Independence.

1. What is data model?

A data model is a collection of concepts that can be used to describe the conceptual/logical structure of a database

1. List relational algebra operations.

The fundamental operations of relational algebra are as follows −

* Select
* Project
* Union
* Set different
* Cartesian product
* Rename

1. What is view?

In SQL, a view is a virtual table based on the result-set of an SQL statement. A view contains rows and columns, just like a real table. The fields in a view are fields from one or more real tables in the database.

1. What is super key?

A superkey is a set of attributes within a relation whose values can be used to uniquely identify a tuple.

1. What is schedule?

A schedule S of n transactions T1, T2, ..., Tn is an ordering of the operations of the transactions. Operations from different transactions can be interleaved in the schedule S. Each transaction Ti that participates in the schedule S, the operations of Ti in S must appear in the same order in which they occur in Ti.

1. What is redundancy?

Redundancy means having multiple copies of same data in the database. This problem arises when a database is not normalized.

1. Define concurrency?

Feature that allows multiple transactions to execute simultaneously.

1. What is transaction?

A transaction is a logical unit of processing in a database which entails one or more database access operation. Transaction must be completed in its entirety to ensure correctness.

1. What is data Recovery?

Transaction failure may cause database to get into inconsistent state. Database recovery is a process of restoring the database to the previous consistent state.

**SET - 2**

1. Define database catalog?

Database catalog contains a complete definition or description of the database structure and constraints. The information stored in the catalog is called meta-data.The catalog is used by the DBMS software and also by database users who need information about the database structure.

1. What is the difference between a database schema and a database state?

A database schema or an intention describes the organization and structure of data in a database system, along with the relationships mapped between the entities. This can be considered as a blueprint of a database. Database state is data in the database at a particular instance of time.

1. Differentiate total and partial participation constraints?

Total Participation requires each entity in the entity set must participate in the relationship whereas for Partial Participation, the entity in the entity set may or may not participate in the relationship.

1. Define relation schema and degree of a relation?

Relation schema is the logical definition of a relation. This includes a set of attributes, the data types associated with each attribute. Relational schema may also refer to as database schema. Degree of a relation specifies the total number of attributes in the relation.

1. What is relational algebra expression?

Relational algebra expression is a procedural language query, which takes instances of relations as input and yields instances of relations as output.

1. Define virtual table in SQL?

A view or virtual table in SQL is a single table that is derived from base tables or previously defined views. A view does not necessarily exist in physical form.

1. What is functional dependency?

A functional dependency is a constraint between two sets of attributes from the database. A functional dependency, denoted by *X* →*Y*, between two sets of attributes *X* and *Y* specifies a *constraint* on the possible tuples of relation state *r* of *R*. The constraint is that, for any two tuples *t*1 and *t*2 in *r* that have *t*1[*X*] = *t*2[*X*], they must also have *t*1[*Y*] = *t*2[*Y*].

1. Define 5NF?

A relation schema *R* is in fifth normal form (5NF) (or project-join normal form (PJNF)) with respect to a set *F* of functional, multivalued, and join dependencies if, for every nontrivial join dependency JD(*R*1, *R*2, ..., *Rn*) in *F*+ every *Ri* is a superkey of *R*.

1. What is transaction? Give an example.

A transaction is a logical unit of processing in a database which entails one or more database access operation. Transaction must be completed in its entirety to ensure correctness.

One example is a transfer from one bank account to another: the complete transaction requires subtracting the amount to be transferred from one account and adding that same amount to the other.

1. What is a lock? List the types of locks used in concurrency control?

A lock is a variable associated with a data item that describes the status of the item with respect to possible operations that can be applied to it. Following types of locks are used in concurrency control.

* Binary locks
* Read/write locks
* Certify locks
* Intention locks

1. What is fuzzy check pointing?

In fuzzy checkpointing, at the time of checkpoint, all the active transactions are written in the log. In case of power failure, the recovery manager processes only those transactions that were active during checkpoint and later. The transactions that have been committed before checkpoint are written to the disk and hence need not be redone.

1. List the commonly accepted threats to database security?

* Loss of integrity.
* Loss of availability.
* Loss of confidentiality.

**SET – 3**

1. What is database?

A database is a collection of related data. data, means known facts that can be recorded and that have implicit meaning.

1. What are the advantages of DBMS?

* Controlling Redundancy
* Restricting Unauthorized Access
* Providing Persistent Storage for Program Objects
* Providing Storage Structures and Search Techniques for Efficient Query Processing
* Providing Backup and Recovery
* Providing Multiple User Interfaces
* Enforcing Integrity Constraints
* Permitting Inferencing and Actions Using Rules

1. Describe the three levels of data abstraction?

* Internal Level: Actual PHYSICAL storage structure and access paths.
* Conceptual or Logical Level: Structure and constraints for the entire database.
* External or View level: Describes various user views.

1. Define the integrity rules?

Integrity rules are the conditions to be satisfied by the database so as to guarantee validity of the data. They are needed to inform the DBMS about certain constraints in the real world.

1. What is data Independence?
2. What is E-R model?

*The*Entity Relationship model*defines the conceptual* view of a database. It works around real-world entities and the associations among them.

1. What is data manipulation Language?

DML is a Database language that is used for performing data insertion, modification, deletion and selection operations on a database.

1. What is normalization?

Normalization of data can be considered a process of analyzing the given relation schemas based on their FDs and primary keys to achieve the desirable properties of (1) minimizing redundancy and (2) minimizing the insertion, deletion, and update anomalies

1. What is lossless join property?

It is a desirable property of decomposition. According to lossless join property, when a relation is decomposed into a set of sub-relations and when the sub-relations are joined back, the resulting relation should be same as the original relation. It ensures that no spurious tuples are generated when a NATURAL JOIN operation is applied to the sub-relations.

1. Define functional dependency?
2. List the ACID properties.

A – Atomicity

C – Consistency Preservation

I – Isolation

D – Durability

1. What are the various types of serialzability?

There are two types of Serializability.

1. Conflict Serializability

2. View Serializability

**SET – 4**

1. Define DBMS?
2. Define schema and instance?

Schema is the formal description of the structure of database whereas Instance is the set of information currently stored in a database at a specific time.

1. Define entities and entities set?

Entity is a real world object that exists either physically or conceptually. An entity set is a set of entities of the same type

1. Define cadinality and arity of a relation?

Cardinality of a relation is the number of tuples in a relation state. The degree (or arity) of a relation is the number of attributes *n* of its relation schema.

1. Write the set operations

In relation algebra following are the set operations.

union, intersection, difference and cartesian product.

1. What is view
2. Define functional dependency
3. Define BCNF

A relation schema *R* is in BCNF if whenever a *nontrivial* functional dependency *X* →*A* holds in *R*, then *X* is a superkey of *R*.

1. Define transactions
2. Define log.

To be able to recover from failures the database system maintains a log to keep track of all transaction operations that affect the values of database items, that may be needed to permit recovery from failures. The log is a sequential, append-only file that is kept on disk.

1. Write the lock modes

* read mode – while transaction reads a data item
* write mode – while transaction writes a data item
* certify mode – while transaction stores modified value of a data item permanently in the database

1. Define lock conversion

A transaction that already holds a lock on item *X* is allowed under certain conditions to convert the lock from one locked state to another. For example, it is possible for a transaction *T* to issue a read\_lock(*X*) and then later to upgrade the lock by issuing a write\_lock(*X*) operation. It is also possible for a transaction *T* to issue a write\_lock(*X*) and then later to downgrade the lock by issuing a read\_lock(*X*) operation.

**SET – 5**

1. Define database?
2. What is schema?
3. What is data independence?
4. What is week entity list?

Entity type that do not have key attributes of its own is called weak entity type. Set of entities of same weak entity type forms weak entity set/list.

1. List relational algebra operations?
2. What is DDL & DML?

DBMS provides Data Definition Language(DDL) for defining the database, i.e., creating tables, altering the definition of existing table, dropping a table etc.

Data Manipulation Language is used for performing insert, delete, update and select operations on a database.

1. What is primary key?

Primary key is the candidate key whose values are used to *identify* tuples in the relation.

1. Define INF?

1NF states that the domain of an attribute must include only *atomic* (simple, indivisible) *values* and that the value of any attribute in a tuple must be a single valuefrom the domain of that attribute.

1. What is schedule?

When transactions are executing concurrently in an interleaved fashion, then the order of execution of operations from all the various transactions is known as a schedule

1. Define log?
2. Define concurrency?
3. What is shadow paging?

Shadow paging is a technique for providing atomicity and durability (two of the ACID properties) in database systems. Shadow paging is a copy-on-write technique for avoiding in-place updates of pages. Instead, when a page is to be modified, a *shadow page* is allocated. Since the shadow page has no references (from other pages on disk), it can be modified liberally, without concern for consistency constraints, etc. When the page is ready to become durable, all pages that referred to the original are updated to refer to the new replacement page instead.

**SET – 6**

1. What is DBMS?
2. Define data model?
3. Define relationship and relationship set?

Relationship defines association among entities of different entity types. Relationship set *R* is a set of relationship instances *ri,* where each *ri* associates *n* individual entities.

1. Define foreign key?

A set of attributes FK in relation schema *R*1 is a foreign key of *R*1 that references relation *R*2 if it satisfies the following rules:

1. The attributes in FK have the same domain(s) as the primary key attributes PK of *R*2
2. A value of FK in a tuple *t*1 of the current state *r*1(*R*1) either occurs as a value of PK for some tuple *t*2 in the current state *r*2(*R*2) *or is NULL*.
3. Define DRC?

Domain relational calculus (DRC) is a declarative database query language for the relational data model.

1. Write DDL commands?

* CREATE – Used for defining a database object
* ALTER - Used for changing the definition of a database object
* DROP – Used for deleting a database object
* TRUNCATE – Used for deleting the records in a database table

1. Define functional dependency?
2. Define 4NF?

A relation schema *R* is in 4NF with respect to a set of dependencies *F* (that includes functional dependencies and multivalued dependencies) if, for every *nontrivial* multivalued dependency *X -*->>*Y* in *F*+, *X* is a superkey for *R*.

1. What is schedule?
2. Define 2PL and give variations of 2PL?

A transaction is said to follow the two-phase locking protocol if *all* locking operations (read\_lock, write\_lock) precede the *first* unlock operation in the transaction. Following are the variations of 2PL.

* Conservative 2PL
* Strict 2PL
* Rigorous 2PL

1. What are ACID properties?

A transaction in a database system must maintain Atomicity, Consistency, Isolation, and Durability − commonly known as ACID properties − in order to ensure accuracy, completeness, and data integrity.

1. Define sub-query?

A subquery is a SELECT statement that is embedded in a clause of another SELECT statement. That other select statement/query is called the outer query.

**SET – 7**

1. What is DBMS? What are its advantages?
2. Define Schema and Instance.
3. Define entity type and attribute.

Attributes are the particular properties of an entity that describe it. For example, an EMPLOYEE entity may be described by the employee’s name, age, address, salary, and job. An entity typedefines a *collection* (or *set*) of entities that have the same attributes. Each entity type in the database is described by its name and attributes.

1. What are relational model constrains?

Various restrictions on data that can be specified on a relational database are called relational model constraints. They can be divided into three main categories:

* inherent model-based constraints or implicit constraints
* schema-based constraints or explicit constraints
* application-based or semantic constraints

1. What are relational algebra operations?
2. What is a view?
3. What is primary key?
4. Explain multi-valued dependencies.

If we have two or more multivalued *independent* attributes in the same relation schema, we get into a problem of having to repeat every value of one of the attributes with every value of the other attribute to keep the relation state consistent and to maintain the independence among the attributes involved. This constraint is specified by a multivalued dependency.

1. What are the transaction properties?
2. What are the phases in 2PL?

* Growing Phase – during which transaction acquires locks
* Shrinking Phase – during which transaction releases the acquired locks

1. Explain concurrency control.

Concurrency control is the mechanism in DBMS for managing transactions that execute simultaneously without conflicting with each another. It helps to make sure that database transactions are performed concurrently without violating the data integrity of respective databases.

1. What is recovery?

**SET – 8**

1. Define database.
2. What is schema?
3. What is data independence?
4. What is week entity set?
5. List relational algebra operators.
6. What is DDL &DML?
7. What is primary key?
8. Define 1NF.
9. What is schedule?
10. Define log.
11. What is concurrency?
12. What is shadow paging?

**SET – 9**

1. Mention the three levels of data abstraction.
2. What is physical data independence?

Capacity of database system to alter physical schema without having to alter conceptual/external schema.

1. Define data model.
2. What is fully functional dependency?

An attribute is fully functional dependent on another attribute, if it is Functionally Dependent on that attribute and not on any of its proper subset.

1. List the primitive operations common to all database management systems.

Any database management system should allow the following primitive operations:

* Database creation
* Database Updation (This includes Insertion, deletion and modification operations)
* Database Lookup

1. Write the two unary operations in relational algebra.

* Select
* Project
* Rename

1. What are the properties of transaction?
2. What is foreign key?
3. Given an example of non-procedural language.

SQL, TRC and DRC are non-procedural languages.

1. Write the two DCL commands.

Commit – makes the changes made to database permanent

rollback – undo the recent updations made to the database

1. What are the two phases in two-phase locking protocol?
2. What is WAL protocol?

When in-place updating is used, the recovery mechanism must ensure that the BFIM of the data item is recorded in the appropriate log entry and that the log entry is flushed to disk before the BFIM is overwritten with the AFIM in the database on disk. This process is known as write-ahead logging protocol. (WAL Protocol)

**SET – 10**

* 1. what is data dictionary and mention its uses?

A data dictionary contains metadata i.e data about the database. The data dictionary is very important as it contains information such as what is in the database, who is allowed to access it, where is the database physically stored etc. The users of the database normally don't interact with the data dictionary; it is only handled by the database administrators.

* 1. How schemas are defined in the three tier architecture?

The goal of the three-schema architecture, is to separate the user applications from the physical database. In this architecture, schemas can be defined at the following three levels:

1. The external or view level includes a number of external schemas or user views. Each external schema describes the part of the database that a particular user group is interested in and hides the rest of the database from that user group.
2. The conceptual level (logical schema) has a conceptual schema, which describes the structure of the whole database for a community of users.
3. The internal level (physical schema) has an internal schema, which describes the physical storage structure of the database.
   1. What are the rule that should be satisfied by the foreign key?
   2. Give examples of weak entity set and strong entity set?

Employee entity type has a key attribute (Employee number) of its own. So it is a strong entity type and set of employee entities forms strong entity set. While dependent entity type doesnot has a key attribute of its own. Dependent entities. are to be related to employee entities in order to get identified. Hence, set of dependent entities form weak entity set.

* 1. What are the rules for writing formulas in tuple relational calculus?

*Rule 1*: Every atom is a formula.

*Rule 2*: If *F*1 and *F*2 are formulas, then so are (*F*1 AND *F*2), (*F*1 OR *F*2), NOT (*F*1), and NOT (*F*2).

*Rule 3*: If *F* is a formula, then so is (∃*t*)(*F*), where *t* is a tuple variable.

*Rule 4*: If *F* is a formula, then so is (∀*t*)(*F*), where *t* is a tuple variable.

* 1. Write SQL command for creating views.

CREATE VIEW *view\_name* AS  
SELECT *column1*, *column2*,…   
FROM *table\_name*  
WHERE *condition*;

* 1. State dependency preservation property.

Each functional dependency *X*🡪*Y* specified in *F* either appeared directly in one of the relation schemas *Ri* in the decomposition *D* or could be inferred from the dependencies that appear in some *Ri*.

* 1. Define partial functional dependency.

A functional dependency *X 🡪* *Y* is a partial dependency if some attribute *A* belonging to *X* can be removed from *X* and the dependency still holds; that is, for some *A* belongs to *X*, (*X* – {*A*}) 🡪*Y*. For ex, the dependency {Ssn, Pnumber}🡪Ename is partial because Ssn→Ename holds.

* 1. State dirty read problem and lost update problem.

Temporary update or dirty read problem occurs when one transaction updates an item and fails. But the updated item is used by another transaction before the item is changed or reverted back to its last value.

In the lost update problem, update done to a data item by a transaction is lost as it is overwritten by the update done by another transaction.

* 1. What is shadow paging?

**SET – 11**

1. Define arity.
2. What is multi valued attribute?
3. Define information.
4. Define data independence.
5. Differentiate between primary key and unique key.

A primary key cannot have NULL values, while unique key can have NULL values. A table can have at most one primary key, while it can have more than one unique keys.

1. What is embedded SQL?

SQL statements can be embedded in a procedural language program for combining data manipulation capabilities of SQL and computing power of any programming language. This is called embedded SQL.

1. What are ACID properties?
2. What is a weak entity?
3. Define serializability.

The concept of **serializability of schedules** is used to identify which schedules are correct when transaction executions have interleaving of their operations in the schedules.

1. Define integrity constraint.

**SET – 12**

1. What is dbms? What are its characteristics?
2. Define data model
3. What are the different entity types?

Strong entity type – Entity type that has its own key attribute for uniquely identifying an entity.

Weak Rntity Type - Entity type that doesn’t has its own key attribute for identifying an entity.

1. Explain unary relational operations.

Relational operation that operates on a single relation is called unary relational operation. For example, Select and Project operations of Relation Algebra are unary operations.

1. What are additional relational operations?

Some common database requests cannot be performed with the original relational algebra operations. Additional operations can express these requests. These operations enhance the expressive power of the original relational algebra. Following are the additional relational algebra operations:

* Generalized Projection
* Aggregate Functions and Grouping
* Recursive Closure Operations
* Outer Join Operations
* Outer union Operation

1. Write the syntax of INSERT query.

INSERT INTO <table name> [ ( <column name> { , <column name> } ) ]  
( VALUES ( <constant value> , { <constant value> } ) { , ( <constant value> { , <constant value> } ) } | <select statement> )

1. What is functional dependency?
2. Explain multivalued dependency.
3. What are the transaction properties?
4. What is multiple granularity locking?

multiple granularity locking is a locking method used in database management systems and relational databases. In multiple granularity locking, locks are set on objects that contain other objects. MGL exploits the hierarchical nature of the contains relationship. For example, a database may have files, which contain pages, which contain records. This can be thought of as a tree of objects, where each node contains its children. A lock on such as a shared or exclusive lock locks the targeted node as well as all of its descendants.

1. What is recovery?
2. What are the database security issues?

* legal and ethical issues regarding the right to access certain information
* Policy issues at the governmental, institutional, or corporate level as to what kinds of information should not be made publicly available.
* System-related issues such as the system levels at which various security functions should be enforced
* The need in some organizations to identify multiple *security levels* and to categorize the data and users based on these classifications

**SET – 13**

1. What is data manipulation language?
2. Define relationship and relationship set.
3. Define entity and attribute.
4. What is query?

A query is a request for data or information from a database. Query can be specified on a database by using various query languages. SQL is one such query language.

1. What the syntax of delete statement.

DELETE FROM <table name> [ WHERE <selection condition> ]

1. Define null values.

Null (or NULL) is a special marker used in SQL to indicate that a data value does not exist in the database. It represents missing or inapplicable information.

1. What is normalization?
2. What is fully functional dependency?
3. List the difference type of anomalies.

* Insertion anomoly
* Deletion anomoly
* Modification anomaly

1. Write the definition of transaction.
2. List the different recovery techniques.

* Recovery techniques based on deferred update
* Recovery techniques based on immediate update
* Shadow paging

1. What is serializability?

**SET – 14**

1. Define DBMS.
2. List the actors on the scene in DBMS.

* Database Administrators
* Database Designers
* End Users
* System Analysts and Application Programmers

1. What is data model and list different data models?
2. Define second normal form.

A relation schema *R* is in second normal form (2NF) if every nonprime attribute *A* in *R* is not partially dependent on *any* key of *R*.

1. Discuss about DML commands.
2. Give the syntax for creating a view in SQL.
3. What is week entity? Given an example.
4. Define strict two phase locking protocol.

A transaction *T* does not release any of its exclusive (write) locks until *after* it commits or aborts. Hence, no other transaction can read or write an item that is written by *T* unless *T* has committed, leading to a strict schedule for recoverability.

1. What are the states of transaction?

A transaction will be in any one of the following states:

* Active
* Partially Committed
* Committed
* Failed
* Terminated

1. Give different types of transaction failures.
   * + A computer failure (system crash).
     + A transaction or system error.
     + Local errors or exception conditions detected by the transaction.
     + Concurrency control enforcement.
     + Disk failure.
     + Physical problems and catastrophes.
2. What is write-ahead logging protocol?

1. Give two types of database security mechanisms

* Discrtionary Access Control
* Mandatory Access Control

**SET – 15**

1. Define data model and list its types.

High-level/ Conceptual Data Model

Implementation/Representation Data Model

Physical Data Model.

1. State any five good heuristic strategies that are used in query optimization.
2. Break up any SELECT operations with conjunctive conditions into a cascade of SELECT operations.
3. Move each SELECT operation as far down the query tree as is permitted by the attributes involved in the select condition.
4. Combine a CARTESIAN PRODUCT operation with a subse- quent SELECT operation in the tree into a JOIN operation, if the condition represents a join condition.
5. Break down and move lists of projection attributes down the tree as far as possible by creating new PROJECT operations as needed.
6. Identify subtrees that represent groups of operations that can be executed by a single algorithm.
7. Give an example for view serializable schedule.

![A close up of a logo

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1. State the advantages of views.

Using Views, user's access to the entire content of table can be restricted by allowing accessing only Views with only required columns of the table. Views eliminate the need to write the complex query.

1. What is an SQL query block? Describe how a query block is translated into extended relational algebra.

SQL queries are decomposed into *query blocks,* which form the basic units that can be translated into the algebraic operators and optimized. A query block contains a single SELECT-FROM-WHERE expression, as well as GROUP BY and HAVING clauses if these are part of the block. Hence, nested queries within a query are identified as separate query blocks.

An SQL query is first translated into an equivalent extended relational algebra expression—represented as a query tree data structure—that is then optimized. The *query optimizer* would then choose an execution plan for each query block.

1. What restrictions are necessary to ensure that view is updatable?

View should be defined on a single table without any aggregate functions. It should not involve any joins.

1. State the differences between super key and primary key.

A Super Key is simply a non-minimal Candidate Key, that is to say one with additional columns not strictly required to ensure uniqueness of the row. A Primary Key is a minimal Candidate Key, which is to say all constituent columns are strictly required in order to ensure uniqueness.

1. What is mean by structural constraint? Given an example.

Cardinality ratio and participation constraints taken together is referred to as the structural constraint of a relationship type. It specifies the maximum and minimum participation of an entity type in a relationship.

For example, the structural constraint on department entity type in works-for relationship can be represented by (1, n) indicating the fact that every department should have at least 1 employee and at most n employees working for it.

1. What is isolation level?

Isolation levels define the degree to which a transaction must be isolated from the data modifications made by any other transaction in the database system.

1. State ACID properties.
2. Write about transaction failures.

Some operation in the transaction may cause it to fail, such as integer overflow or division by zero. Transaction failure may also occur because of erroneous parameter values or because of a logical programming error. Additionally, the user may interrupt the transaction during its execution.

1. Write the syntax of the REVOKE IN SQL.

REVOKE <privilege> ON <database table> FROM <user>;

For example, REVOKE SELECT ON EMPLOYEE FROM A3;

**SET – 16**

1. Define data.
2. What is a composite attribute?

**Composite attributes** can be divided into smaller subparts, which represent more basic attributes with independent meanings. For example, the Address attribute of the EMPLOYEE entity can be subdivided into Street, address, City, State, and Zip

1. Define degree of a relationship.
2. Define transaction.
3. Differentiate between where clauses and having clause.

Where clause specifies condition on individual rows while having clause specifies condition on group of rows.

1. List the aggregate functions.

* count()
* sum()
* max()
* min()
* Avg()

1. What is shadow paging?
2. What is dynamic sq1?

Dynamic SQL is a programming technique that enables to build SQL statements dynamically at runtime. more general purpose, flexible applications can be created by using dynamic SQL because the full text of a SQL statement may be unknown at compilation.

1. List difference type of database backup techniques.

**Normal or Full Backups -** runs on a selected drive, all the files on that drive are backed up.

**Incremental Backups** - will grab**only the files that have been updated since the last normal backup**

### Differential Backups

### Daily Backups

1. What is join?

The JOIN operation, is used to combine *related tuples* from two relations into single “longer” tuples. This operation is very important for any relational database with more than a single relation because it allows us to process relationships among relations.