Subject Name: Database Management System **Semester: IV**

Multiple Choice Questions

	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	Which of the following is true about Data Independence? It is the ability:
Option A:	To modify schema definition in one level without affecting schema definition in the next lower level.
Option B:	To modify schema definition in one level without affecting schema definition in the next higher level.
Option C:	To modify data in one level without affecting the data in the next lower level.
Option D:	To modify data in one level without affecting the data in the next higher level.
2.	Data redundancy leads to higher storage and access cost. It may lead to
Option A:	Data isolation
Option B:	Data inconsistency
Option C:	Integrity problem
Option D:	Atomicity
3.	The an attribute (say X) of entity set is calculated from other attribute value (say Y). The attribute X is called
Option A:	Single valued
Option B:	Multi valued

Option C:	Composite
Option D:	Derived
4.	A weak entity type always has a total participation constraint w.r.t. its identifying relationship, because
Option A:	Weak entity have a partial key
Option B:	Weak entity cannot be identified with an owner entity.
Option C:	Weak entity cannot be identified without an owner entity.
Option D:	Weak entity cannot identified without an identifying relationship
5.	In an Entity-Relationship (ER) model, suppose R is a one-to-many relationship from entity set E1 to entity set E2. Assume that E1 and E2 participate totally in R and that the cardinality of E2 is greater than the cardinality of E1. Which one of the following is true about R?
Option A:	Every entity in E1 is associated with exactly one entity in E2.
Option B:	Some entities in E1 are associated with more than one entity in E2.
Option C:	Every entity in E2 is associated with exactly one entity in E1.
Option D:	Every entity in E2 is associated with at most one entity in E1.
6.	The type of operation which extends the Projection operation by allowing functions of attributes to be included in the projection list.
Option A:	Join
Option B:	Generalized Projection
Option C:	Projection
Option D:	Aggregate functions
7.	i. What is union compatibility ?
Option A:	Two or more table share the same number of columns
Option B:	Two or more tables share the same number of columns and same domain
Option C:	Two or more tables have the same degree
Option D:	Two or more tables share the same domains

8.	$r \cap s =$
Option A:	r – (r – s)
Option B:	s – (r – s)
Option C:	(r u s) – (r – s)
Option D:	(r u s) /(s u r)
9.	Let E1 and E2 be two entities in an E-R diagram with one multi-valued attribute in E1,R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many and R2 is many-to-many,R1 and R2 do not have any attributes of their own,What is the minimum number of tables required to represent this situation in the relational model.
Option A:	2
Option B:	4
Option C:	3
Option D:	5
10.	Write a query to set default value for salary to 25000 for table employee
Option A:	UPDATE employee MODIFY salary DEFAULT 25000
Option B:	UPDATE employee SET salary To DEFAULT 25000
Option C:	ALTER TABLE employee SET salary To DEFAULT 25000
Option D:	ALTER TABLE employee MODIFY salary DEFAULT 25000
11.	i. Consider the employee table:employee (employee id, name, dept name,salary)Create a new employee `E-101', named `Ashwin singh', with 50,000 salary for department `developer'. Identify the appropriate SQL.
Option A:	INSERT INTO TABLE employee VALUES (`E-101',`Ashwin Singh',`Wireless', 100000)
Option B:	INSERT INTO employee (`E-101',`Ashwin Singh',`DEVELOPER', 50000)
Option C:	INSERT INTO employee VALUES(`E-101',`Ashwin Singh',`DEVELOPER', 50000)
Option D:	INSERT INTO employee table(employee id, name, dept name, salary) VALUES (`E-101',`Ashwin Singh',`DEVELOPER', 50000)

<table>
<tr><td></td><td></td></tr>
<tr><td>12.</td><td>Consider the following instance:
<table><tr><td>Name</td><td>Price</td></tr><tr><td>IPHONE</td><td>5000</td></tr><tr><td>PHONE</td><td>1500</td></tr><tr><td>LAPTOP</td><td>1000</td></tr><tr><td>IPAD</td><td>5500</td></tr></table>The following Query is executed
SELECT Price from Product order by Name DESC;
Find out correct order of tuple numbers in the output ,if the tuple numbers in the above table are 1,2,3,4</td></tr>
<tr><td>Option A:</td><td>2,3,4,1</td></tr>
<tr><td>Option B:</td><td>3,4,2,1</td></tr>
<tr><td>Option C:</td><td>4,1,2,3</td></tr>
<tr><td>Option D:</td><td>2,3,1,4</td></tr>
<tr><td></td><td></td></tr>
<tr><td>13.</td><td>a. Which of the following statement is CORRECT ?</td></tr>
<tr><td>Option A:</td><td>Every relation in 3NF is also in BCNF</td></tr>
<tr><td>Option B:</td><td>A relation R is in 3NF if every non-prime attribute of R is fully functionally dependent on every key of R</td></tr>
<tr><td>Option C:</td><td>Every relation in BCNF is also in 3NF</td></tr>
<tr><td>Option D:</td><td>No relation can be in both BCNF and 3NF</td></tr>
<tr><td></td><td></td></tr>
<tr><td>14.</td><td>Let R= (A,B,C,D,E,F) be a relation with the following dependencies. C->F, E->A, EC->D, A->B. Which of the following is a key for R</td></tr>
<tr><td>Option A:</td><td>CD</td></tr>
<tr><td>Option B:</td><td>EC</td></tr>
<tr><td>Option C:</td><td>AE</td></tr>
<tr><td>Option D:</td><td>AC</td></tr>
<tr><td></td><td></td></tr>
<tr><td>15.</td><td>Consider relational schema</td></tr>
</table>

	Member(phone,name,address,room,floor,stay) which satisfies following FDs: phone,name->address Phone->Room name->floor,stay. The given relation satisfies which highest normal form?
Option A:	1NF
Option B:	2NF
Option C:	3NF
Option D:	BCNF
16.	What is true about timestamp based ordering protocol
Option A:	Ensure both conflict serializability and freedom from deadlock
Option B:	Ensure only conflict serializability
Option C:	Ensure only freedom from deadlock
Option D:	Ensure only view serializability
17.	Identify correct rules in growing phase (first phase) in two-phase locking protocol.
Option A:	Transaction can only acquire shared lock(lock-s) and exclusive (lock-X)
Option B:	transaction can only acquire shared lock(lock-s) ,exclusive (lock-X) and covert lock-s to lock-X
Option C:	transaction can release shared lock(lock-s) ,release exclusive (lock-X) and covert lock-s to lock-X
Option D:	transaction can acquire only shared lock(lock-s) and release exclusive (lock-X)
18.	Suppose in a database, there are three transactions T1, T2 and T3 with timestamp 10, 20 and 30 respectively. T2 is holding a data item which T1 and T3 are requesting to acquire. Which of the following statement is correct in respect of Wait-die Deadlock Prevention scheme?
Option A:	Transaction T1 will wait for T2 to release the data item.
Option B:	Transaction T1 will be aborted.
Option C:	Transaction T3 will wait for T2 to release the data item.

Option D:	Transaction T2 will wait for T1 to release the data item.
19.	Choose correct statement regarding immediate database modification method of log based recovery method
Option A:	Only Redo operation is performed
Option B:	Redo and undo operations are performed
Option C:	Only undo operation is performed
Option D:	No redo and undo operations are performed
20.	When transactions execute properly without interference from concurrently executing transactions then this property is referred to as.
Option A:	Atomicity
Option B:	Concurrency
Option C:	Consistency
Option D:	Isolation
21.	Which is not a level in three level schema architecture?
Option A:	conceptual schema
Option B:	Abstraction level
Option C:	external schema
Option D:	internal schema
22.	The operation produces a new relation with only some of the attributes of R, and removes duplicate tuples.
Option A:	Union
Option B:	Intersect
Option C:	Select
Option D:	Project
23.	In which operation the resultant relation contains all pairs of tuples from the two relations, regardless of whether their attribute values match.

Option A:	Join
Option B:	Set Difference
Option C:	Cartesian product
Option D:	Union
24.	What is not true for a file based system to store data?
Option A:	Provides data consistency
Option B:	More redundancy
Option C:	No security
Option D:	Difficulty in accessing data.
25.	In SQL which CLAUSE is used to apply conditions on a group?
Option A:	ON
Option B:	WHERE
Option C:	HAVING
Option D:	GROUP BY
26.	An ER model of a database consists of entity types E1 and E2. These are connected by a relationship R which does not have its own attribute. Under which one of the following conditions, can the relational table for R be merged with that of E1?
Option A:	Relationship R is one-to-many and the participation of E1 in R is total.
Option B:	Relationships are one-to-many and the participation of E1 in R is partial.
Option C:	Relationship R is many-to-one and the participation of E1 in R is total.
Option D:	Relationship R is many-to-one and the participation of E1 in R is partial.
27.	Consider the relation Sailors:

Sid	Sname	Rating	Age
22	Dustin	7	45.0
29	Brutus	1	33.0

31	Lubber	8	55.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0

What will be the output if following query?

SELECT AVG (S.age)

FROM Sailors S

WHERE S.rating = 10;

Option A:	20
Option B:	10.5
Option C:	25.5
Option D:	30
28.	Which concurrency control protocols ensure freedom from deadlock?
Option A:	2-phase locking
Option B:	Timestamp Ordering
Option C:	Validation Based
Option D:	Strict 2-phase locking
29.	The Join operation in which it keeps every tuple in first or left relation R if no matching tuple is found in S, then the attributes of S in join result filled with NULL values
Option A:	Left outer join
Option B:	Right outer join
Option C:	Full join
Option D:	Inner join
30.	Consider the employee table:employee (employee id, name, dept name, salary) Create a new employee `E-101', named `Ashwin singh', with 50,000 salary for department `developer'. Identify the appropriate SQL.

Option A:	INSERT INTO TABLE employee VALUES (`E-101',`Ashwin Singh',`Wireless', 10,00,000)
Option B:	INSERT INTO employee (`E-101',`Ashwin Singh',`DEVELOPER', 50,000)
Option C:	INSERT INTO employee VALUES(`E-101',`Ashwin Singh',`DEVELOPER', 50,000)
Option D:	INSERT INTO employee table(employee id, name, dept name, salary) VALUES (`E-101',`Ashwin Singh',`DEVELOPER', 50,000)
31.	An association between an entity and itself is called?
Option A:	Binary relationship
Option B:	Recursive relationship
Option C:	Aggregation
Option D:	Specialization
32.	If several concurrent transactions are executed over the same data set and the second transaction updates the database before the first transaction is finished, the _____property is violated and the database is no longer consistent
Option A:	Atomicity
Option B:	Consistency
Option C:	Durability
Option D:	Isolation
33.	"Consider a relation R (A, B, C, D, E, F, G, H), where each attribute is atomic, and following functional dependencies exist. CH → G , A → BC, B → CFH, E → A, F → EG The relation R is_____."
Option A:	in 1NF but not in 2NF
Option B:	in 2NF but not in 3NF
Option C:	in 3NF but not in BCNF
Option D:	in BCNF
34.	In the process of normalization, the decomposition should satisfy the following properties

Option A:	lossy but dependency preserving
Option B:	lossless but not dependency preserving
Option C:	lossless and dependency preserving
Option D:	lossy and not dependency preserving
35.	Relation R=(A,B,C,D,E,G) having the functional dependencies F=(A->B, BG->E, C->D, D->G) What is the candidate key?
Option A:	BG
Option B:	AB
Option C:	ABG
Option D:	AC
36.	The scheme of database recovery is that all the updates of transactions are recorded in the database on disk before the transaction commits.
Option A:	Immediate update
Option B:	Deferred update
Option C:	Shadow paging
Option D:	Checkpoint
37.	Consider following 2 schedules S1:r1(X);r3(Y);r3(X);r2(Y);r2(Z);w3(Y);w2(Z);r1(Z);w1(X);w1(Z) S2: r1(X); r3(Y); r2(Y); r3(X); r1(Z);r2(Z); w3(Y); w1(X); w2(Z);w1(Z);W3(Z)
Option A:	S1 and S2 both are conflict serializable
Option B:	only S1 is conflict serializable
Option C:	only S2 is conflict serializable
Option D:	S1 and S2 both are not conflict serializable

38.	a. Choose the option that correctly explains in words, the function of the following relational algebra expression **b.** $\sigma_{\text{year} \geq 2017 \ \wedge \ \text{salary} < 42000}(\text{Employee})$ c.
Option A:	Selects all tuples from the Employee
Option B:	Selects all the tuples from Employee wherever the year is lesser than 2017 and salary less than 42000
Option C:	Selects all the tuples from the Employee wherever the year is greater than or equal to 2017 and salary is less than 42000.
Option D:	Selects all tuples from the Employee wherever the year is greater than or equal to 2009
39.	When a person in the university is belonging to more than one lower level entity set such as student as well as faculty then the constraint is
Option A:	Disjoint
Option B:	Total
Option C:	Overlapping
Option D:	Partial
40.	Consider the following two statements about database transaction schedules: I. Strict two-phase locking protocol generates conflict serializable schedules that are also recoverable. II. Timestamp-ordering concurrency control protocol with Thomas' Write Rule can generate view serializable schedules that are conflict serializable. Which of the above statements is/are TRUE?
Option A:	I only
Option B:	II only
Option C:	I and II both
Option D:	Neither I nor II
41.	The capacity to alter the database schema at one level without affecting any other levels is termed as

Option A:	Data Independence
Option B:	Data Mapping
Option C:	Data Isolation
Option D:	Data Transformation
42.	Which of the following describes the database structure and constraints?
Option A:	View
Option B:	Schema
Option C:	Meta data
Option D:	Instance
43.	Overlapping with partial specialization constraint can be defined as
Option A:	When a higher level entity instance may be a member of multiple lower level Entities or it must be a member of at least one lower level entity set..
Option B:	When a higher level entity instance may be a member of multiple lower level Entities or it does not have to be a member of any lower level entity.
Option C:	When an entity instance may be a member of at most one lower level entity set.
Option D:	When an entity instance may be a member of at least one lower level entity set..
44.	If car is the entity type then Maruti 800, Swift dzire are the ?
Option A:	Instance
Option B:	Schema
Option C:	Field
Option D:	Attribute
45.	a. How to form the primary key of a weak entity set?
Option A:	Using weak entity set discriminator attribute only
Option B:	By combining all the attributes of weak entity set
Option C:	Using primary key of identifying entity set and discriminator of weak entity set
Option D:	Not possible to have primary key for weak entity set
46.	If relation r contains Nr tuples, and relation s contains Ns tuples, then the result of which operation contains Nr × Ns tuples?
Option A:	Union

Option B:	Join
Option C:	Cartesian Product
Option D:	Set difference
47.	Consider the following relations: Parts(pid,pname,color) PartCost(pid,cost) What does the following relational algebra expression represent? $\Pi_{pid}((\sigma_{color='red'} (Parts)) \bowtie (\sigma_{cost \geq 1000}(PartCost)))$
Option A:	Find the pid of all parts whose color is red.
Option B:	Find the pid of all parts whose color is red or cost $\geq$ 1000.
Option C:	Find the pid of all parts whose color is red but not cost $\geq$ 1000.
Option D:	Find the pid of all parts whose color is red and cost $\geq$ 1000 .
48.	i. What is the cardinality of column A, if a relation R(A,B,C,D,E) contains 40 rows and every column contains unique values.
Option A:	200
Option B:	40
Option C:	4
Option D:	20
49.	Consider Entity set A and B in ER diagram having many to many relationship between A and B. How to map this relationship into a relational model?
Option A:	By adding primary key of Entity set A as a foreign key component in Entity set B
Option B:	By adding primary key of Entity set B as a foreign key component in Entity set A
Option C:	By creating a separate relation(R) for mapping binary many to many relationships which includes the primary key of both A and B.

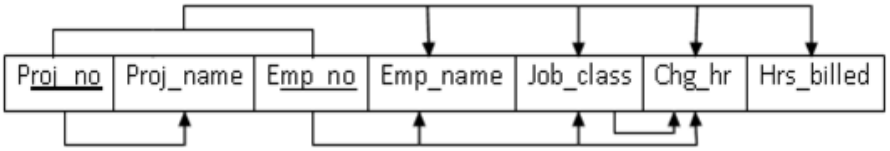
Option D:	By creating combine relation for entity set A and B
50.	Consider Table Employees have 10 records and it has NOT NULL salary column which is also UNIQUE. SELECT COUNT(*) FROM Employee WHERE SALARY > ANY (SELECT SALARY FROM EMPLOYEE); How many rows will come in the OUTPUT of the given query?
Option A:	10
Option B:	5
Option C:	9
Option D:	0
51.	Consider Schema: **Dept(dept_name, location, city);** Which command can be used to delete column location from the given relation
Option A:	MODIFY TABLE Dept DROP COLUMN location;
Option B:	ALTER TABLE Dept DROP COLUMN location;
Option C:	ALTER TABLE Dept DROP location;
Option D:	MODIFY TABLE Dept DROP location;
52.	Consider the instructor table: INSTRUCTOR (instr_id, name, dept name, salary) Create a new instructor `I-101', named `Ashwin singh', with 50,000 salary for department `Maths'. Identify the appropriate SQL staerment.
Option A:	INSERT INTO TABLE instructor VALUES (`I-101',`Ashwin Singh',`science', 10,00,000)
Option B:	INSERT INTO instructor (`I-101',`Ashwin Singh',`Maths', 50,000)
Option C:	INSERT INTO instructor VALUES(`I-101',`Ashwin Singh',`Maths', 50,000)
Option D:	INSERT INTO instructor tableinstr_id, name, dept name, salary) VALUES (`I-101',`Ashwin Singh',`maths', 50,000)

53.	Consider a relation R(A,B,C,D,) with the following functional dependency: AB-> CD . The number of superkeys of R is:
Option A:	1
Option B:	2
Option C:	3
Option D:	4
54.	Identify the incorrect statement .
Option A:	3NF doesn't have transitive dependencies
Option B:	Composite attributes are not allowed in 1NF
Option C:	In 2NF ,there should not be any Full functional dependencies
Option D:	In BCNF, trivial FD are allowed
55.	consider the relation schema: Student_Performance (name, courseNo, rollNo, grade) has the following set of functional dependencies. F= { rollNo,courseNo->grade rollNo->name } and candidate key is (rollNo,courseNo) The highest normal form of this relation scheme is
Option A:	2NF
Option B:	3NF
Option C:	1NF
Option D:	BCNF
56.	If T1 , T2 are two transactions and I1 , I2 are two instructions of T1 and T2 respectively then I1 and I2 are conflicting instructions if
Option A:	They operate on the different data item
Option B:	They belong to different transactions
Option C:	At Least one of them is a write operation
Option D:	At Least one of them is a read operation

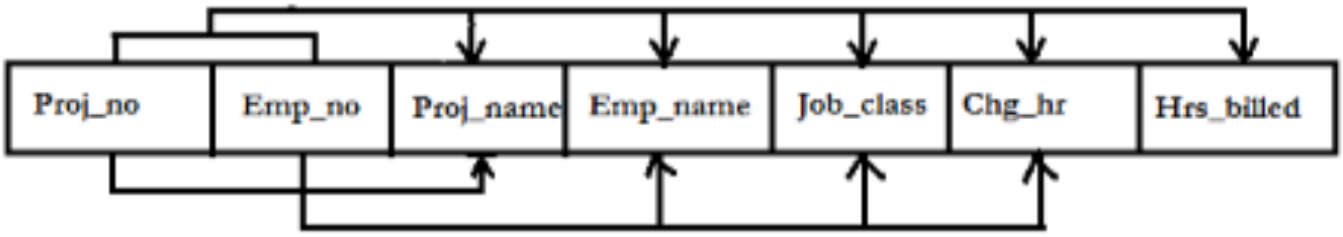
57.	What is true about the Wait-Die Algorithm for deadlock handling.
Option A:	Preemptive
Option B:	Non-preemptive
Option C:	Prefers Younger Transactions
Option D:	Both B And C
58.	i. Identify correct rules in growing phase (first phase) in two-phase locking protocol.
Option A:	Transaction can acquire only shared lock(LOCK-S) and exclusive (lock-X)
Option B:	Transaction can acquire only shared lock(LOCK-s) ,exclusive (lOCK-X) and covert Lock-S to Lock-X
Option C:	Transaction can release shared lock(LOCK-s) ,release exclusive (lOCK-X) and covert Lock-S to Lock-X
Option D:	Transaction can acquire only shared lock(LOCK-S) and release exclusive (lock-X)
59.	Choose the correct option
Option A:	Every Conflict serializable schedule is also View serializable
Option B:	Every View serializable schedule is also conflict serializable
Option C:	Both a and b
Option D:	Every serial schedule has same conflict and view equivalent schedule
60.	When a transaction is aborted due to ant kind of failure,which instruction should be executed to keep database in consistent state
Option A:	Commit
Option B:	Rollback
Option C:	Savepoint
Option D:	Checkpoint

Descriptive Questions

1. Consider a dependency diagram of relation R and normalize it up to third normalform.

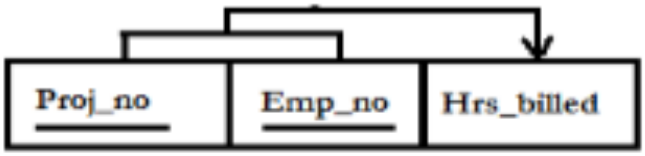


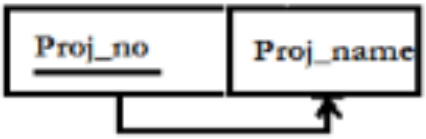
Redrawing the original diagram, we get -

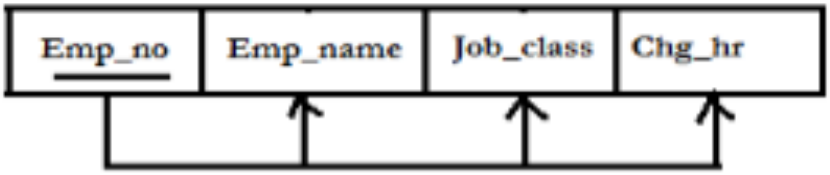


(Intermediate steps you can now very well do it, looking at previous problem)

Final Relation in 3NF form:







Normalized relation,

- Employees (Proj_no, Emp_no, Proj_name, Emp_name, Job_Class, Chg_Hr, Hrs_Billed)
- With set of FDs
- Proj_no, Emp_np -> Proj_name, Emp_name, Job_Class, Chg_Hr, Hrs_Billed

  Emp_no -> Emp_name, Job_Class,Chg_Hr

  Proj_no -> Proj_name

  Job_Class -> Chg_Hr

2. Explain conflict and view serializability with suitable examples .

Ans.

View Serializability

- A schedule will view serializable if it is view equivalent to a serial schedule.
- If a schedule is conflict serializable, then it will be view serializable.
- The view serializable which does not conflict serializable contains blind writes.

View Equivalent

Two schedules S1 and S2 are said to be view equivalent if they satisfy the following conditions:

1. Initial Read

An initial read of both schedules must be the same. Suppose two schedule S1 and S2. In schedule S1, if a transaction T1 is reading the data item A, then in S2, transaction T1 should also read A.

T1	T2
Read(A)	
	Write(A)

Schedule S1

T1	T2
	Write(A)
Read(A)	

Schedule S2

Above two schedules are view equivalent because Initial read operation in S1 is done by T1 and in S2 it is also done by T1.

2. Updated Read

In schedule S1, if Ti is reading A which is updated by Tj then in S2 also, Ti should read A which is updated by Tj.

T1	T2	T3
Write(A)		
	Write(A)	
		Read(A)

Schedule S1

T1	T2	T3
	Write(A)	
Write(A)		
		Read(A)

Schedule S2

Above two schedules are not view equal because, in S1, T3 is reading A updated by T2 and in S2, T3 is reading A updated by T1.

3. Final Write

A final write must be the same between both the schedules. In schedule S1, if a transaction T1 updates A at last then in S2, final writes operations should also be done by T1.

T1	T2	T3
Write(A)	Read(A)	Write(A)

Schedule S1

T1	T2	T3
Write(A)	Read(A)	Write(A)

Schedule S2

Above two schedules is view equal because Final write operation in S1 is done by T3 and in S2, the final write operation is also done by T3.

Example:

T1	T2	T3
Read(A) Write(A)	Write(A)	Write(A)

Schedule S

With 3 transactions, the total number of possible schedule

= 3! = 6
S1 = <T1 T2 T3>
S2 = <T1 T3 T2>
S3 = <T2 T3 T1>
S4 = <T2 T1 T3>
S5 = <T3 T1 T2>
S6 = <T3 T2 T1>

Taking first schedule S1:

T1	T2	T3
Read(A) Write(A)	Write(A)	Write(A)

Schedule S1

Step 1: final updation on data items
In both schedules S and S1, there is no read except the initial read that's why we don't need to check that condition.
Step 2: Initial Read
The initial read operation in S is done by T1 and in S1, it is also done by T1.
Step 3: Final Write
The final write operation in S is done by T3 and in S1, it is also done by T3. So, S and S1 are view Equivalent.
The first schedule S1 satisfies all three conditions, so we don't need to check another schedule.
Hence, view equivalent serial schedule is:

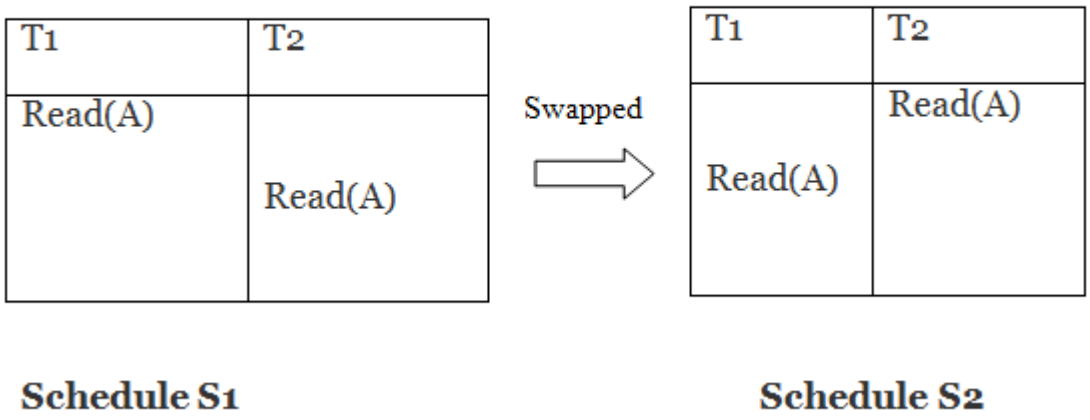
T1 → T2 → T3

Conflict Serializable Schedule

- A schedule is called conflict serializability if after swapping of non-conflicting operations, it can transform into a serial schedule.
- The schedule will be a conflict serializable if it is conflict equivalent to a serial schedule.

Conflicting Operations
The two operations become conflicting if all conditions satisfy:
1.Both belong to separate transactions.
2.They have the same data item.
3.They contain at least one write operation.
Example:
Swapping is possible only if S1 and S2 are logically equal.

1. T1: Read(A) T2: Read(A)



Schedule S1 **Schedule S2**

Here, S1 = S2. That means it is non-conflict.

2. T1: Read(A) T2: Write(A)

T1	T2
Read(A)	
	Write(A)

Swapped

T1	T2
	Write(A)
Read(A)	

Schedule S1 **Schedule S2**

Here, S1 ≠ S2. That means it is conflict.

Conflict Equivalent

In the conflict equivalent, one can be transformed to another by swapping non-conflicting operations. In the given example, S2 is conflict equivalent to S1 (S1 can be converted to S2 by swapping non-conflicting operations).

Two schedules are said to be conflict equivalent if and only if:

They contain the same set of the transaction.

If each pair of conflict operations are ordered in the same way.

Example:

Non-serial schedule

T1	T2
Read(A)	
Write(A)	
	Read(A)
	Write(A)
Read(B)	
Write(B)	
	Read(B)
	Write(B)

Schedule S1

Serial Schedule

T1	T2
Read(A)	
Write(A)	
Read(B)	
Write(B)	
	Read(A)
	Write(A)
	Read(B)
	Write(B)

Schedule S2

Schedule S2 is a serial schedule because, in this, all operations of T1 are performed before starting any operation of T2. Schedule S1 can be transformed into a serial schedule by swapping non-conflicting operations of S1.

After swapping of non-conflict operations, the schedule S1 becomes:

T1	T2
Read(A) Write(A) Read(B) Write(B)	Read(A) Write(A) Read(B) Write(B)

Since, S1 is conflict serializable.

3. Explain deadlock handling in DBMS with suitable examples.

Ans.

A deadlock is a condition where two or more transactions are waiting indefinitely for one another to give up locks. Deadlock is said to be one of the most feared complications in DBMS as no task ever gets finished and is in waiting state forever.

For example: In the student table, transaction T1 holds a lock on some rows and needs to update some rows in the grade table. Simultaneously, transaction T2 holds locks on some rows in the grade table and needs to update the rows in the Student table held by Transaction T1.

Now, the main problem arises. Now Transaction T1 is waiting for T2 to release its lock and similarly, transaction T2 is waiting for T1 to release its lock. All activities come to a halt state and remain at a standstill. It will remain in a standstill until the DBMS detects the deadlock and aborts one of the transactions.

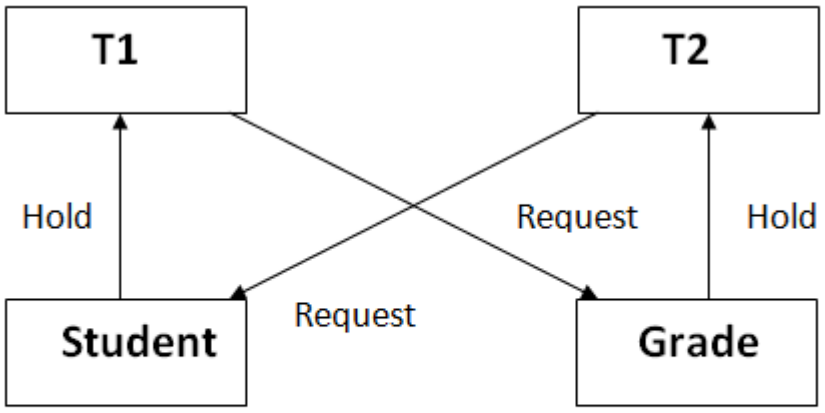


Figure: Deadlock in DBMS

Deadlock Avoidance

- When a database is stuck in a deadlock state, then it is better to avoid the database rather than aborting or restating the database. This is a waste of time and resource.
- Deadlock avoidance mechanism is used to detect any deadlock situation in advance. A method like "wait for graph" is used for detecting the deadlock situation but this method is suitable only for the smaller database. For the larger database, deadlock prevention method can be used.

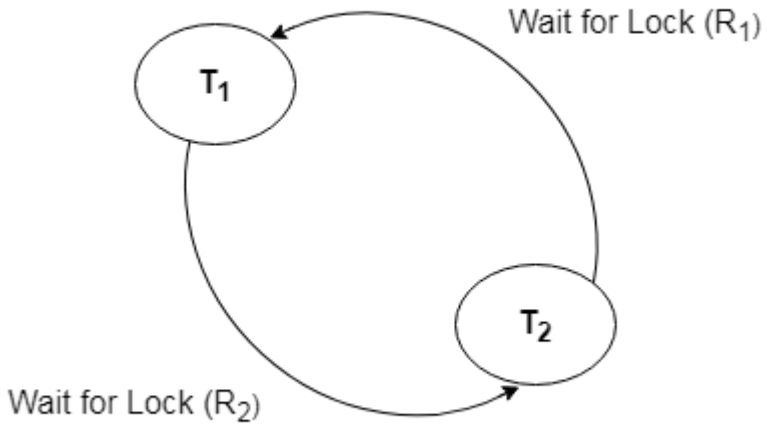
Deadlock Detection

In a database, when a transaction waits indefinitely to obtain a lock, then the DBMS should detect whether the transaction is involved in a deadlock or not. The lock manager maintains a Wait for the graph to detect the deadlock cycle in the database.

Wait for Graph

- This is the suitable method for deadlock detection. In this method, a graph is created based on the transaction and their lock. If the created graph has a cycle or closed loop, then there is a deadlock.
- The wait for the graph is maintained by the system for every transaction which is waiting for some data held by the others. The system keeps checking the graph if there is any cycle in the graph.

The wait for a graph for the above scenario is shown below:



Deadlock Prevention

- Deadlock prevention method is suitable for a large database. If the resources are allocated in such a way that deadlock never occurs, then the deadlock can be prevented.

- The Database management system analyzes the operations of the transaction whether they can create a deadlock situation or not. If they do, then the DBMS never allowed that transaction to be executed.

Wait-Die scheme

In this scheme, if a transaction requests for a resource which is already held with a conflicting lock by another transaction then the DBMS simply checks the timestamp of both transactions. It allows the older transaction to wait until the resource is available for execution.

Let's assume there are two transactions Ti and Tj and let TS(T) is a timestamp of any transaction T. If T2 holds a lock by some other transaction and T1 is requesting for resources held by T2 then the following actions are performed by DBMS:

1. Check if TS(Ti) < TS(Tj) - If Ti is the older transaction and Tj has held some resource, then Ti is allowed to wait until the data-item is available for execution. That means if the older transaction is waiting for a resource which is locked by the younger transaction, then the older transaction is allowed to wait for resource until it is available.
2. Check if TS(T_i) < TS(Tj) - If Ti is older transaction and has held some resource and if Tj is waiting for it, then Tj is killed and restarted later with the random delay but with the same timestamp.

Wound wait scheme

- In wound wait scheme, if the older transaction requests for a resource which is held by the younger transaction, then older transaction forces younger one to kill the transaction and release the resource. After the minute delay, the younger transaction is restarted but with the same timestamp.
- If the older transaction has held a resource which is requested by the Younger transaction, then the younger transaction is asked to wait until older releases it.

4. What are different database users? Give responsibilities of DBA

Ans.

1. Naïve users

o Naïve users are users who interact with the system using application programs that have been developed previously

o For eg, student wants to pay fees Rs.50 then accountant will invoke a program called fees_payment(). This program asks the accountant for the amount of fees to be paid

o Naïve users can read reports generated from the database

2. Application programmers

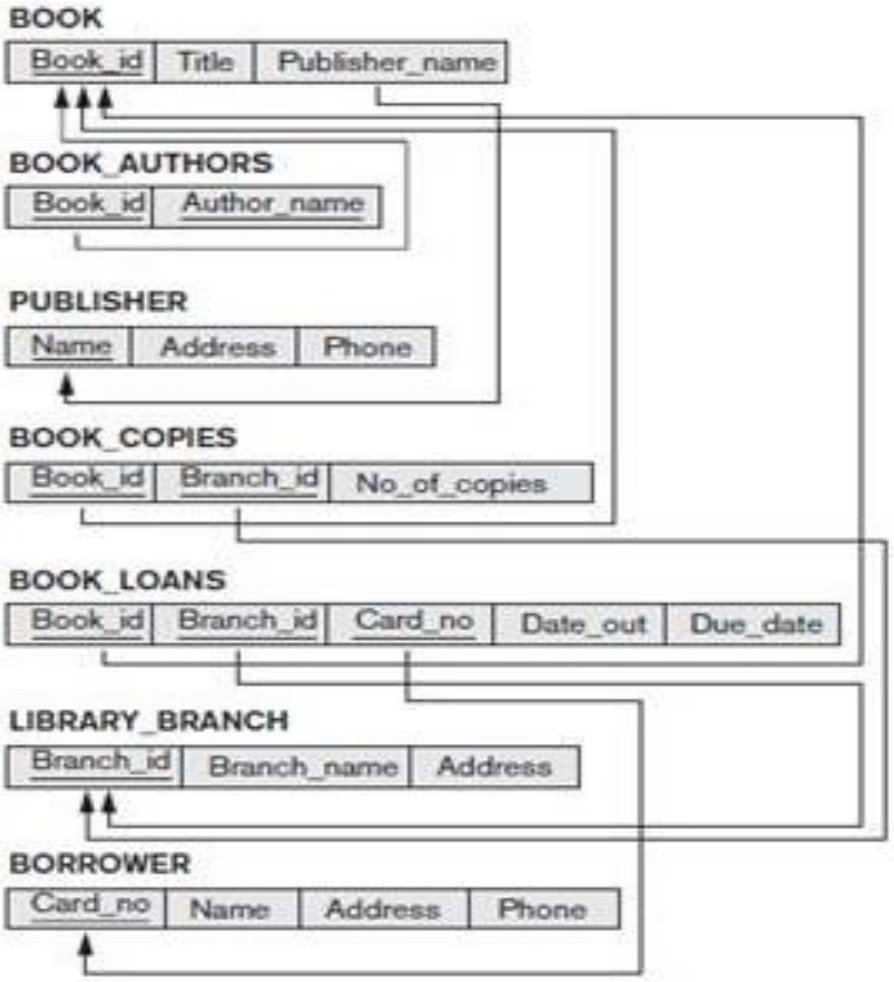
o Application programmers responsible for writing application programs that use the

database
o Application programmers are developers or computer professionals who write application programs
o Application programmers develop user interfaces using any preferred language
o Rapid application development (RDA) tools are available nowadays that enable an application programmer to construct application without writing code

3. Sophisticated users
o Sophisticated users interact with application without writing programs by using a database query language
o This query will be solved by query processor
o Online analytical processing (OLAP) tools is used to view summaries of data in different ways which helps analysts (eg sales of region, city etc.) with OLAP analysts can use data mining tools , which help them find certain kinds of patterns in data

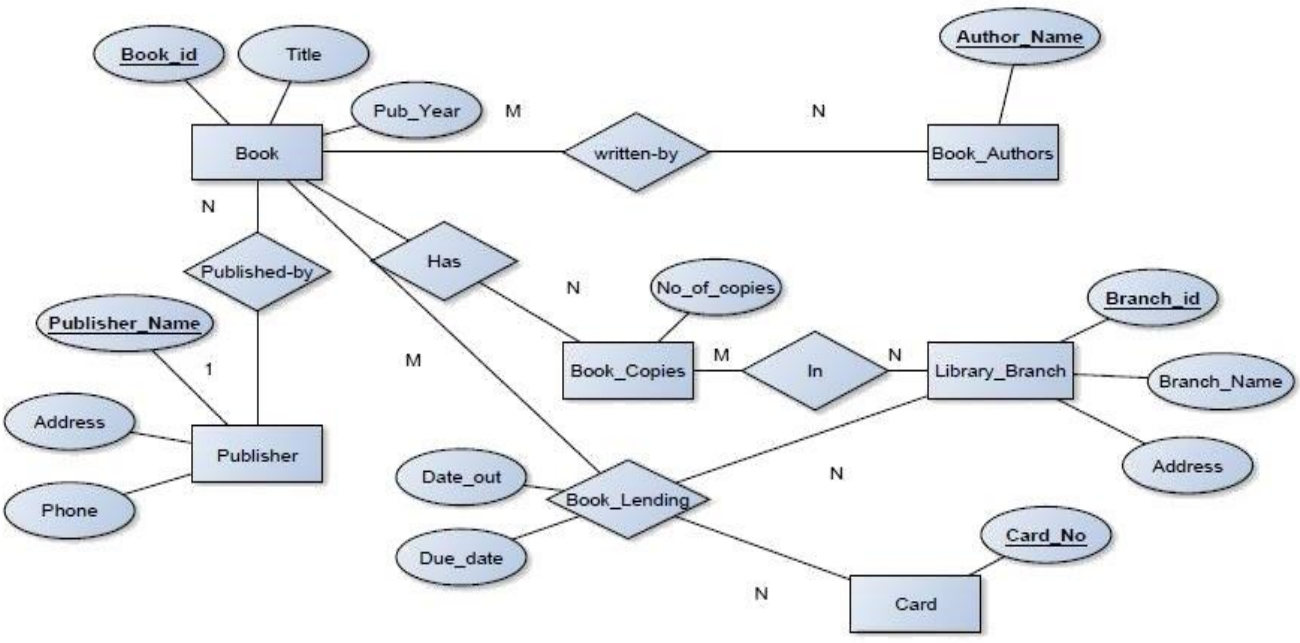
4. Specialized users
o Creates the actual database and implements technical controls needed to enforce various policy decisions
o Specialized users are sophisticated users who develop database applications
The responsibilities of DBA are as follows –
- Makes the decision concerning the content of the database.
- Plans the storage structure and access strategy.
- Provides the support to the users.
- Defines the security and integrity checks.
- Interpreter backup and recovery strategies.
- Monitoring the performance and responding to the changes in the requirements.

5. Produce ER Diagram from the following relational database Schema.



Ans.

Entity-Relationship Diagram



6. Book(book_id, title,author, cost)
Store(store_no, city, state, inventory_val)
Stock(store_no, book_id,quantity)

Consider above relational schema and formulate SQL queries for the following:

(i)Modify the cost of DBMS books by 10%
(ii)Find the author of the books which are available in Mumbai store
(iii)Find the title of the most expensive book
(iv) Find the total quantity of books in each store
(v) Add a new record in Book(Assume values as per requirement)

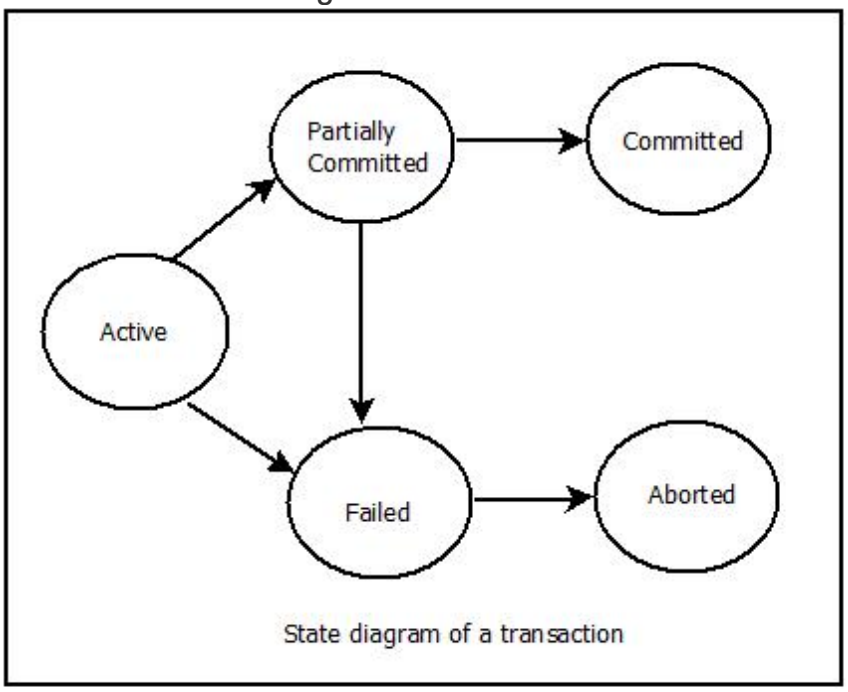
Ans.

7. Explain the transaction processing with the help of a state diagram?

Ans.

• A transaction is the sequence of one or more SQL statements that are combined together to form a single unit of work.

Transaction State Diagram:



State diagram of a transaction

Transaction must be in one of these states:

1.Active:
• It is the initial state if a transaction.
• Execution of transaction starts in an active state.
• Transaction remains in an active state till its execution is in process.
2. Partially Committed:
• When the last operation of a transaction is executed it goes to a partially committed state.
• Here there is a possibility that the transaction may be aborted or else it goes to committed state.
3.Failed:
• A transaction goes to a Failed state if it is determined that it can no longer proceed with its normal exection.
4.Aborted:
• Failed transaction when rolled back is in an aborted state.
• In this stage system has two options:
1) *Restart the transaction*: A restarted transaction is considered to be new transaction which may recover from possible failure.
2) *Kill the transaction*: A transaction can be killed to recover from failure.
5.Committed:
• The transaction when successfully completed comes to this state.
• Transaction is said to be terminated if its neither committed nor aborted.

8. Consider the schema R={A,B,C,D,E,F,G,H,I,J} and set of functional dependencies

F= {{A,B}→{C}, {A}→{D,E}, {B}→ {F}, {F}→{G,H},{D}→{I,J}}.

What is the key of R?
Decompose R into 2NF and 3NF relations.
Ans.

Solution:
A→DE (given) => A→D and A→ D
Since A→D and D→IJ (given) => A→IJ
Using the union rule A→ ADEIJ, thus AB → ABDEIJ (augmentation)
Also AB→C (given) => AB→ ABCDEIJ.
Since B→F (given) and F→ GH (given), B→GH (transitivity)
Thus AB→AGH holds. Also AB→AF holds from B→F (given)
Finally, using the union rule AB→ABCDEFGHIJ.
So AB is a key. This can also be determined by calculating AB^+ with respect to the set F.

2NF	3NF	
R1 (A, B, C)	R1 (A, B, C)	
R2 (A,D,E,I,J)	R2.1 (A,D,E)	R2.2 (D, I, J)
R3 (B, F, G, H)	R3.1 (B, F)	R3.2 (F, G, H)

9. Explain log based recovery techniques with examples?

Ans.

Log-Based Recovery

The log is a sequence of records. Log of each transaction is maintained in some stable storage so that if any failure occurs, then it can be recovered from there.

If any operation is performed on the database, then it will be recorded in the log.

But the process of storing the logs should be done before the actual transaction is applied in the database.

Let's assume there is a transaction to modify the City of a student. The following logs are written for this transaction.

When the transaction is initiated, then it writes 'start' log.

<Tn, Start>

When the transaction modifies the City from 'Noida' to 'Bangalore', then another log is written to the file.

<Tn, City, 'Noida', 'Bangalore' >

When the transaction is finished, then it writes another log to indicate the end of the transaction.

<Tn, Commit>

There are two approaches to modify the database:

1. Deferred database modification:

The deferred modification technique occurs if the transaction does not modify the database until it has committed.

In this method, all the logs are created and stored in the stable storage, and the database is updated when a transaction commits.

2. Immediate database modification:

The Immediate modification technique occurs if database modification occurs while the transaction is still active.

In this technique, the database is modified immediately after every operation. It follows an actual database modification.

Recovery using Log records

When the system is crashed, then the system consults the log to find which transactions need to be undone and which need to be redone.

If the log contains the record <Ti, Start> and <Ti, Commit> or <Ti, Commit>, then the Transaction Ti needs to be redone.

If log contains record<T_n, Start> but does not contain the record either <Ti, commit> or <Ti, abort>, then the Transaction Ti needs to be undone.

10. Design an EER schema for a **BANK** database.

Each bank can have multiple branches, and each branch can have multiple accounts and loans. Bank keeps the track of different types of Accounts (Saving_aacount, Checking_account) , Loans(Car_loans,Home_loans,…) , each account's Transaction (deposit, withdrawal,check,..) and each loan's Payments; both of these include the amount, date and time.

State any assumptions you make about the additional requirement clearly.

Ans.

11. Write SQL queries for the given database :

Emp(Eid, Ename, Sal, City)

Works(Eid, Cid)

Company(Cid, Cname, City)

i. Find the lowest paid employee.

ii. Find how many employees are working for the company ‘ANZ Cooperation”.

iii. Modify the database so that Joe now lives in “New York”.

iv. Find the total number of employees of each company.

v. Give all employees of ‘XYZ ‘company a 10% raise in salary.

Ans.

1.Find the lowest paid employee

2.Find how many employees are working for the company ‘ANZ Cooperation”

```
Select count * From employee
From Company
Where  Cname = ‘ANZ Cooperation’;
```

3.Modify the database so that joe now lives in “New York”

```
Update employee
Set city = ‘New York’
Where name = ‘Joe’;
```

4.Find the total number of employees of each company

```
Select count * From employee;
```

5. Give all employees of ‘XYZ’ company a 10% raise in salary

```
Update employee
```

```
Set sal = (sal + (0.1 * sal))
Where eid = ( Sected eid from emp
                where Cid = (select eid
                              from company
                               where company_name = 'XYZ');
```

12. Explain the three levels of abstraction in DBMS including physical and logicaldata independence.

Ans.

Data Abstraction is a process of hiding unwanted or irrelevant details from the end user. It provides a different view and helps in achieving data independence which is used to enhance the security of data.

The database systems consist of complicated data structures and relations. For users to access the data easily, these complications are kept hidden, and only the relevant part of the database is made accessible to the users through data abstraction.

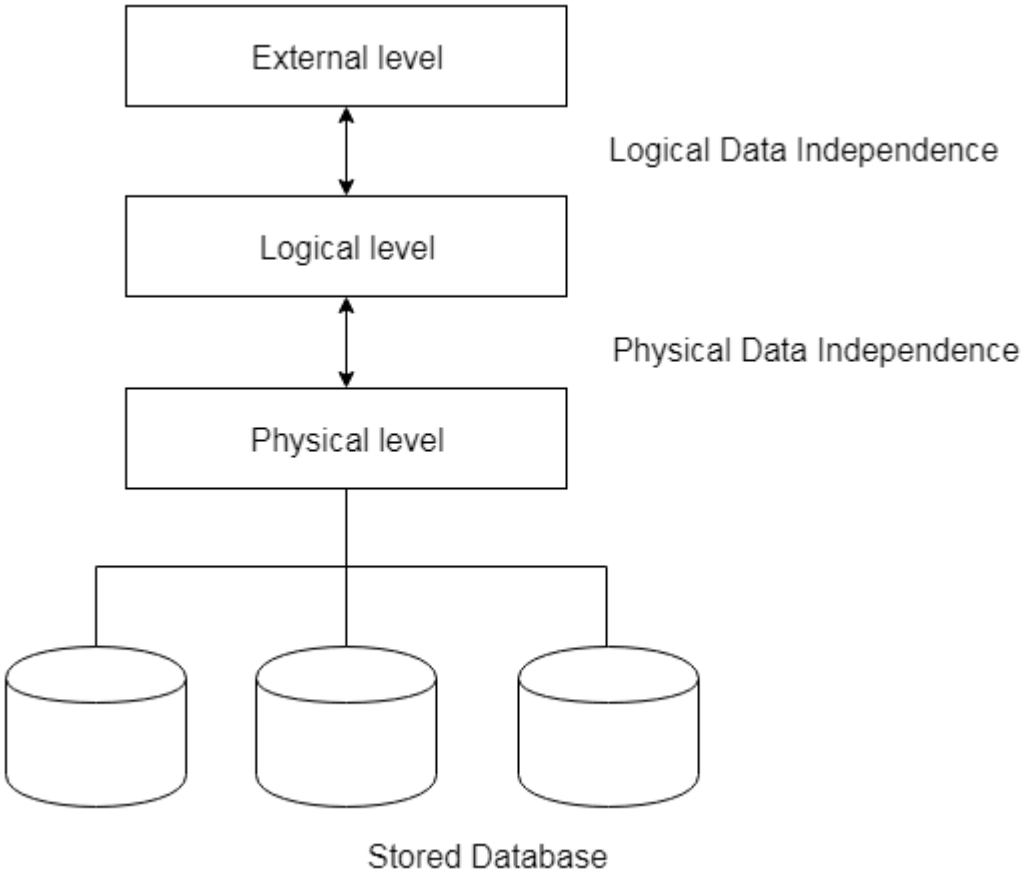
Levels of abstraction for DBMS

Database systems include complex data-structures. In terms of retrieval of data, reduce complexity in terms of usability of users and in order to make the system efficient, developers use levels of abstraction that hide irrelevant details from the users. Levels of abstraction simplify database design.

Mainly there are three levels of abstraction for DBMS, which are as follows −

- Physical or Internal Level
- Logical or Conceptual Level
- View or External Level

These levels are shown in the diagram below −



Physical or Internal Level

It is the lowest level of abstraction for DBMS which defines how the data is actually stored, it defines data-structures to store data and access methods used by the database. Actually, it is decided by developers or database application programmers how to store the data in the database.

So, overall, the entire database is described in this level that is physical or internal level. It is a very complex level to understand. For example, customer's information is stored in tables and data is stored in the form of blocks of storage such as bytes, gigabytes etc.

Logical or Conceptual Level

Logical level is the intermediate level or next higher level. It describes what data is stored in the database and what relationship exists among those data. It tries to describe the entire or whole data because it describes what tables to be created and what are the links among those tables that are created.

It is less complex than the physical level. Logical level is used by developers or database administrators (DBA). So, overall, the logical level contains tables (fields and attributes) and relationships among table attributes.

View or External Level

It is the highest level. In view level, there are different levels of views and every view only defines a part of the entire data. It also simplifies interaction with the user and it provides many views or multiple views of the same database.

View level can be used by all users (all levels' users). This level is the least complex and easy to understand.

For example, a user can interact with a system using GUI that is view level and can enter details at GUI or screen and the user does not know how data is stored and what data is stored, this detail is hidden from the user.

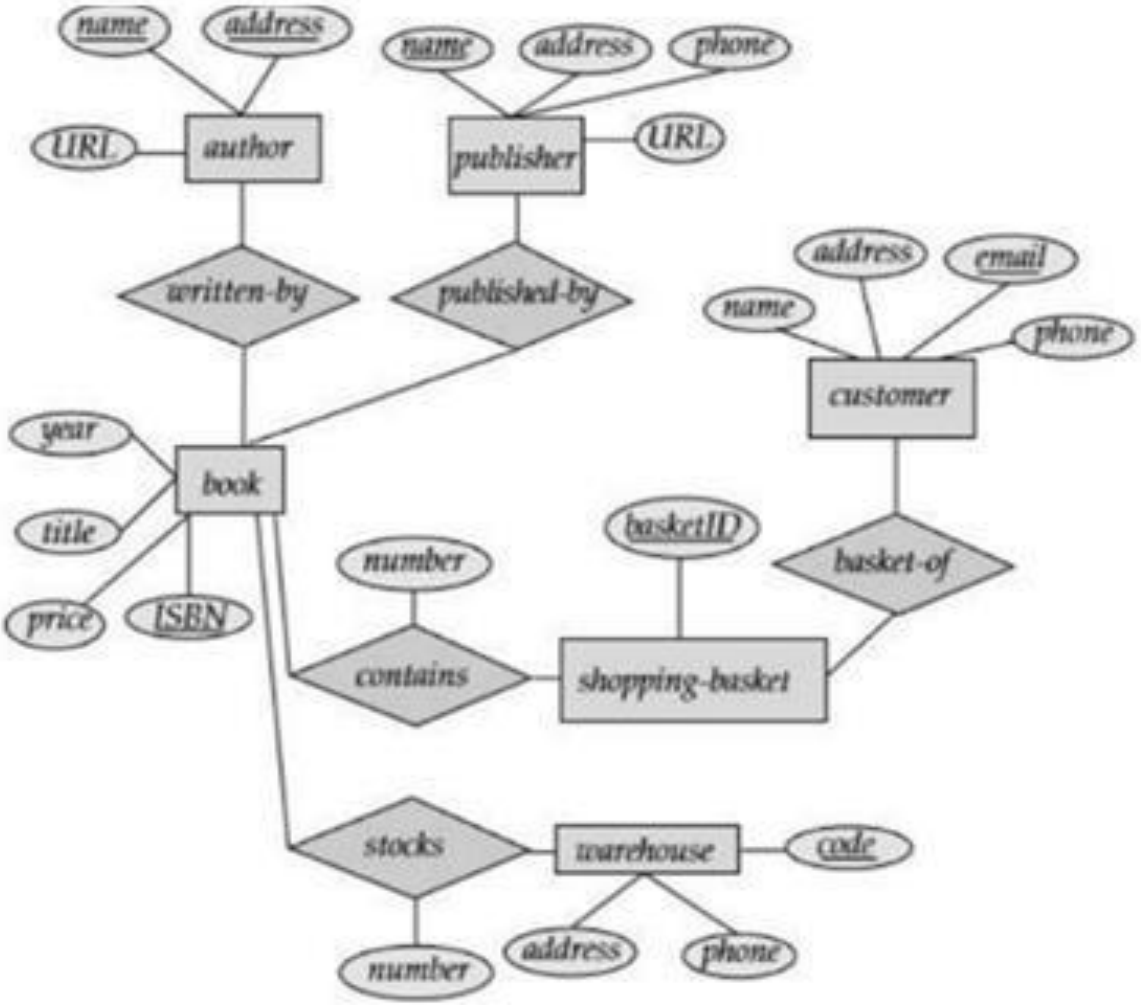
13. Consider the given schema:

- **Employees (**Empid, Fname, Lname, Email, Phoneno, Hiredate, Jobid,Salary, Mid, Did**)**
- **Departments** (Did, Dname,Managerid)
- **Locations** (Did, City,State)

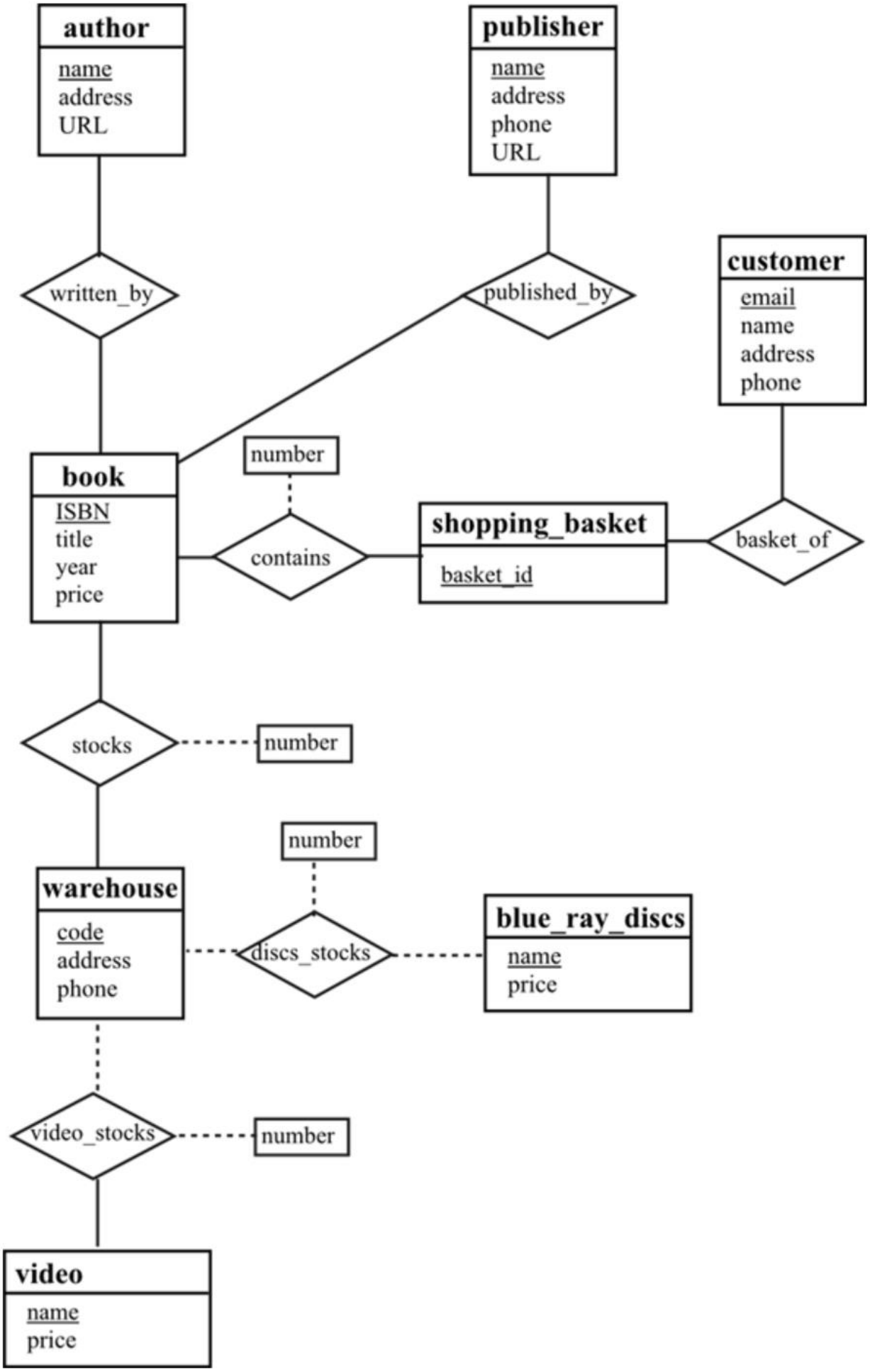
Write the SQL queries for the following:

1. List the employees who have a manager who works for a departmentbased in Mumbai.
2. Give a 10% hike to all the Employees working in '**D01'** department.
3. Display the information of the employees whose first name startswith 'R' in descending order of their salary.
4. Find name of the department which are having more than 20 employees
5. Add a new record in departments(Assume values as per requirement)

14. Convert following E-R diagram to relational schema and equivalent schemadiagram

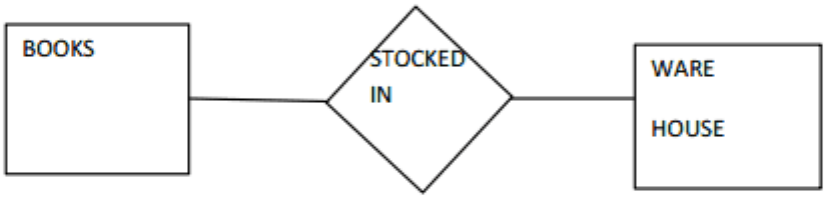

name
address
name
address
phone
URL
author
publisher
URL
written-by
published-by
address
email
name
phone
customer
year
book
title
basketID
basket-of
number
price
ISBN
contains
shopping-basket
stocks
warehouse
code
number
address
phone

The extended E-R diagram after adding Blu-ray discs and downable video is as follows:

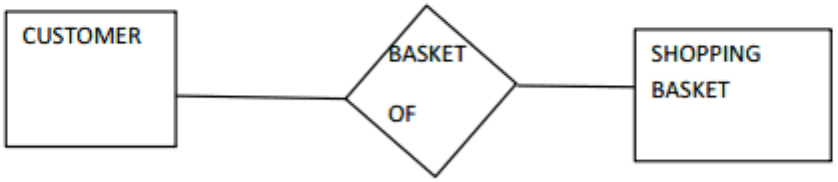


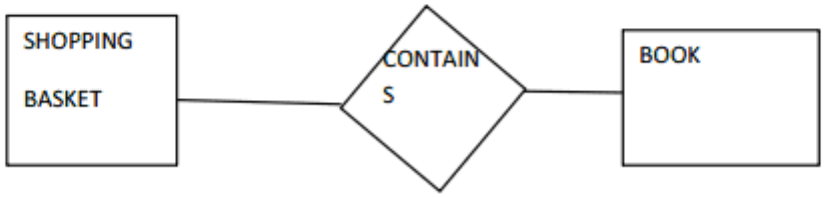
M:N CARDINALITY

N:1 CARDINALITY



1:N CARDINALITY





AUTHOR

NAME	ADDRESS	URL

BOOK

ISBN	PRICE	TITLE	YEAR

PUBLISHER

NAME	ADDRESS	PHONE	URL

CUSTOMER

EMAIL	NAME	ADDRESS	PHONE

SHOPPING_BASKET

BASKETID

WAREHOUSE

CODE	PHONE	ADDRESS

CONTAINS

ISBN	BASKETID	NUMBER

STOCKS

CODE	ISBN	NUMBER

WRITTEN_BY

NAME	ISBN

PUBLISHED_BY

NAME	ISBN

BASKET_OF

EMAIL	BASKETID

15. Explain 3NF .Consider relation r1 with the functional dependencies that hold on it.

r1(p, q, r, s, t)
p → q,r,s,t
s → t

check whether r1 is in 3NF or not .If it is not in 3NF decompose into 3NF.

Ans. Third Normal Form (3NF)

- A relation will be in 3NF if it is in 2NF and not contain any transitive partial dependency.
- 3NF is used to reduce the data duplication. It is also used to achieve the data integrity.
- If there is no transitive dependency for non-prime attributes, then the relation must be in third normal form.

A relation is in third normal form if it holds atleast one of the following conditions for every non-trivial function dependency X → Y.

1. X is a super key.
2. Y is a prime attribute, i.e., each element of Y is part of some candidate key.

16. Explain transaction ,properties and states with suitable example

Ans.

Transaction

- The transaction is a set of logically related operation. It contains a group of tasks.
- A transaction is an action or series of actions. It is performed by a single user to perform operations for accessing the contents of the database

Operations of Transaction:

Following are the main operations of transaction:

Read(X): Read operation is used to read the value of X from the database and stores it in a buffer in main memory.

Write(X): Write operation is used to write the value back to the database from the buffer.

Let's take an example to debit transaction from an account which consists of following operations:

1. 1. R(X);
2. 2. X = X - 500;
3. 3. W(X);

Let's assume the value of X before starting of the transaction is 4000.

- The first operation reads X's value from database and stores it in a buffer.
- The second operation will decrease the value of X by 500. So buffer will contain 3500.
- The third operation will write the buffer's value to the database. So X's final value will be 3500.

But it may be possible that because of the failure of hardware, software or power, etc. that transaction may fail before finished all the operations in the set.

For example: If in the above transaction, the debit transaction fails after executing operation 2 then X's value will remain 4000 in the database which is not acceptable by the bank.

To solve this problem, we have two important operations:

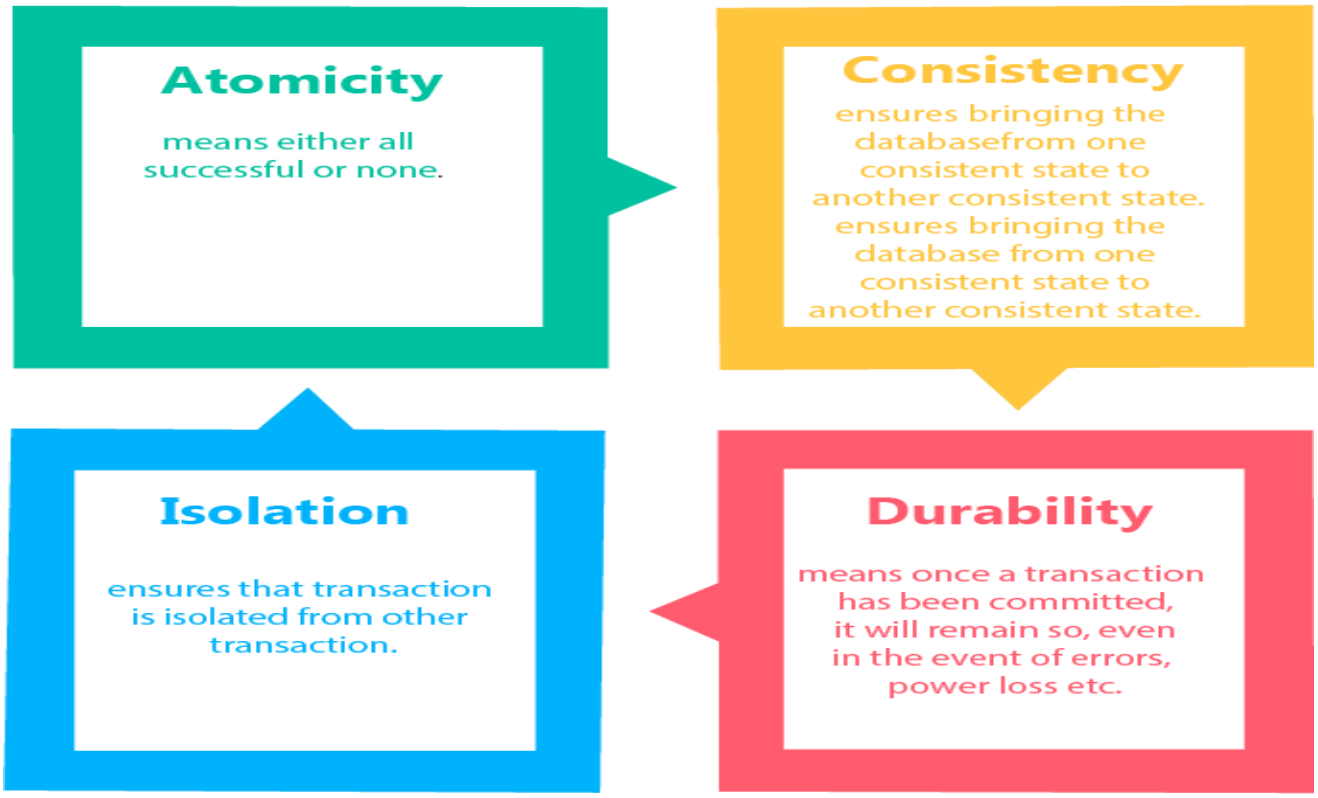
Commit: It is used to save the work done permanently.

Rollback: It is used to undo the work done.

The transaction has the four properties. These are used to maintain consistency in a database, before and after the transaction.

Property of Transaction

1. Atomicity
2. Consistency
3. Isolation
4. Durability



Atomicity

- It states that all operations of the transaction take place at once if not, the transaction is aborted.
- There is no midway, i.e., the transaction cannot occur partially. Each transaction is treated as one unit and either run to completion or is not executed at all.

Atomicity involves the following two operations:

Abort: If a transaction aborts then all the changes made are not visible.

Commit: If a transaction commits then all the changes made are visible.

Consistency

- The integrity constraints are maintained so that the database is consistent before and after the transaction.
- The execution of a transaction will leave a database in either its prior stable state or a new stable state.
- The consistent property of database states that every transaction sees a consistent database instance.
- The transaction is used to transform the database from one consistent state to another consistent state.

Isolation

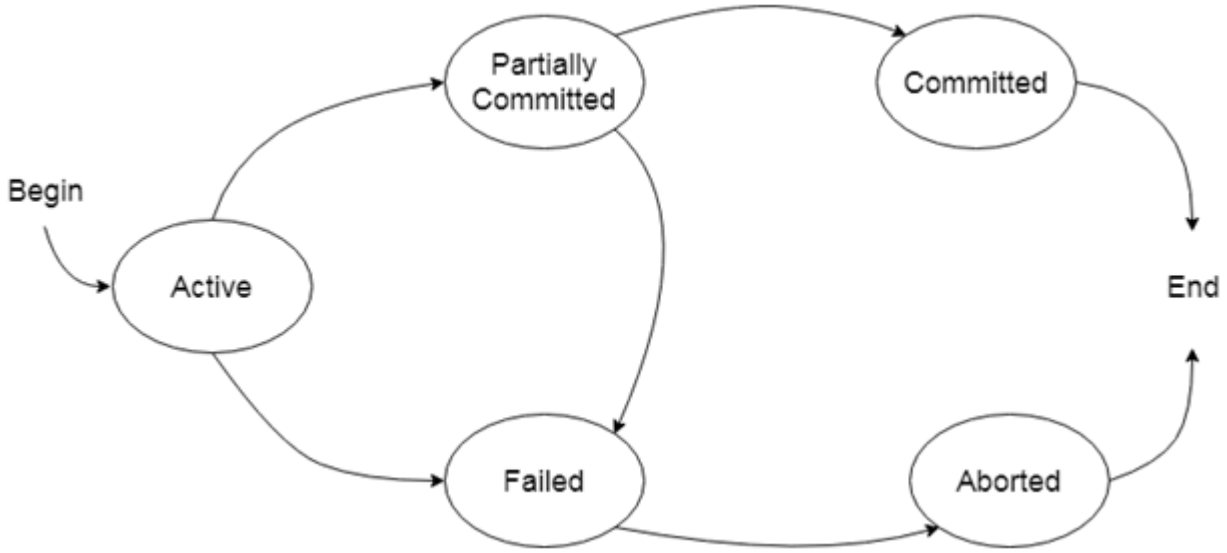
- It shows that the data which is used at the time of execution of a transaction cannot be used by the second transaction until the first one is completed.
- In isolation, if the transaction T1 is being executed and using the data item X, then that data item can't be accessed by any other transaction T2 until the transaction T1 ends.
- The concurrency control subsystem of the DBMS enforced the isolation property.

Durability

- The durability property is used to indicate the performance of the database's consistent state. It states that the transaction made the permanent changes.
- They cannot be lost by the erroneous operation of a faulty transaction or by the system failure. When a transaction is completed, then the database reaches a state known as the consistent state. That consistent state cannot be lost, even in the event of a system's failure.
- The recovery subsystem of the DBMS has the responsibility of Durability property.

States of Transaction

In a database, the transaction can be in one of the following states -



Active state

- The active state is the first state of every transaction. In this state, the transaction is being executed.
- For example: Insertion or deletion or updating a record is done here. But all the records are still not saved to the database.

Partially committed

- In the partially committed state, a transaction executes its final operation, but the data is still not saved to the database.
- In the total mark calculation example, a final display of the total marks step is executed in this state.

Committed

A transaction is said to be in a committed state if it executes all its operations successfully. In this state, all the effects are now permanently saved on the database system.

Failed state

- If any of the checks made by the database recovery system fails, then the transaction is said to be in the failed state.
- In the example of total mark calculation, if the database is not able to fire a query to fetch the marks, then the transaction will fail to execute.

Aborted

- If any of the checks fail and the transaction has reached a failed state then the database recovery system will make sure that the database is in its previous consistent state. If not then it will abort or roll back the transaction to bring the database into a consistent state.
- If the transaction fails in the middle of the transaction then before executing the transaction, all the executed transactions are rolled back to its consistent state.
- After aborting the transaction, the database recovery module will select one of the two operations:
    1. Re-start the transaction
    2. Kill the transaction

17. Explain timestamp based protocol and how timestamp-ordering protocol guarantees serializability

Ans.

Timestamp-based Protocols

The most commonly used concurrency protocol is the timestamp based protocol. This protocol uses either system time or logical counter as a timestamp.

Lock-based protocols manage the order between the conflicting pairs among transactions at the time of execution, whereas timestamp-based protocols start working as soon as a transaction is created.

Every transaction has a timestamp associated with it, and the ordering is determined by the age of the transaction. A transaction created at 0002 clock time would be older than all other transactions that come after it. For example, any transaction 'y' entering the system at 0004 is two seconds younger and the priority would be given to the older one.

In addition, every data item is given the latest read and write-timestamp. This lets the system know when the last ‘read and write’ operation was performed on the data item

The timestamp-ordering protocol ensures serializability among transactions in their conflicting read and write operations. This is the responsibility of the protocol system that the conflicting pair of tasks should be executed according to the timestamp values of the transactions.

A conflict occurs when an older transaction tries to read/write a value already read or written by a younger transaction. Read or write proceeds only if the last update on that data item was carried out by an older transaction.

Otherwise, the transaction requesting read/write is restarted and gives a new timestamp. Here no locks are used so no deadlock.

- The timestamp of transaction Ti is denoted as TS(Ti).
- Read time-stamp of data-item X is denoted by R-timestamp(X).
- Write time-stamp of data-item X is denoted by W-timestamp(X).

These timestamps are updated after a successful read/write operation on data item X.

Older transactions get priority over younger transactions in the event of conflict operation. Conflict is resolved by rolling back and restarting transactions.

Rules for a transaction

To ensure serializability following rules are used −

Rule 1 − If a transaction Ti issues a read(X) operation.

If TS(Ti) < W-timestamp(X)

Operation rejected.

If TS(Ti) >= W-timestamp(X)

Operation executed.

All data-item timestamps updated.

Rule 2 − If a transaction Ti issues a write(X) operation.

If TS(Ti) < R-timestamp(X)

Operation rejected.

If TS(Ti) < W-timestamp(X)

Operation rejected and Ti rolled back.

Otherwise, the operation is executed.

Thomas' Write Rule

This rule states if TS(Ti) < W-timestamp(X), then the operation is rejected and Ti is rolled back.

Time-stamp ordering rules can be modified to make the schedule view serializable.

Instead of making Ti rolled back, the 'write' operation itself is ignored.

EFFECT − Thomas Write Rule allows such operations and is a modification on the Basic Timestamp Ordering protocol. In Thomas Write Rule users ignore outdated writes