

## Transaction Processing:-

Transaction processing is a smallest individual unit of the data base. It can use some operation i.e. insert operation, update operation & delete operation.

→ Transaction processing uses two operation

### (1) Read operation:-

In read operation the data items can be copied from temporary memory to data base.

### (2) Write operation:-

In write operation the data items copied from temporary memory to data base.

→ Transaction processing uses some properties. This property is known as ACID properties.

A - Atomicity

C - Consistency

I - Isolation

D - Durability

### (i) Atomicity:-

Every transaction must be atomic i.e. it should not be breakable into smaller transaction.

### (ii) Consistency:-

In consistency the result should not be changed due to the environmental effect.

### (iii) Isolation:-

The transaction should not be affected by the presence of environment.

### (iv) Durability:-

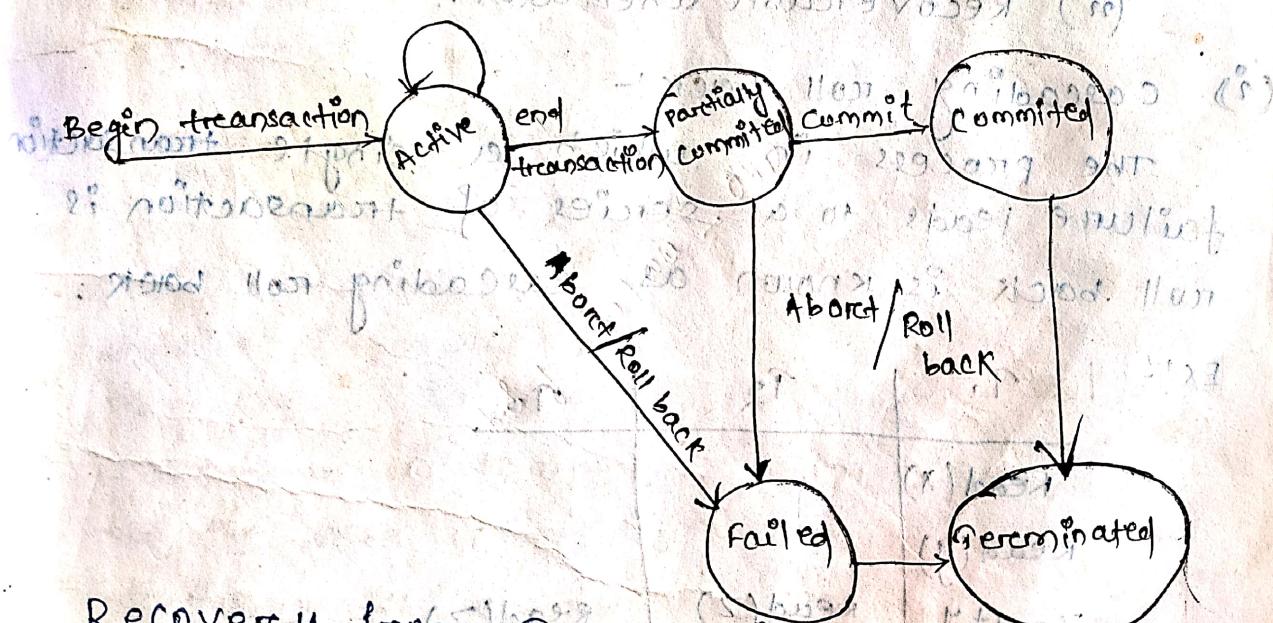
The transaction should not die before finishing the task.

### States of Transaction:-

There are six types of states are present in the transaction.

- (i) Begin transaction:- It can start the transaction
- (ii) End transaction:- It can stop the transaction
- (iii) Read transaction
- (iv) Write transaction
- (v) Commit :- Successful end. of transaction
- (vi) Abort :- Unsuccessful end of transaction

### Diagram of transaction



### Recovery from Transaction Failure:-

- A computer system like any other device is subject to failure. There may be several causes of such failure that includes disk crash, software error or power failure.

- There are 2 types of failures are present
- Loss of volatile storage
  - Non-volatile storage loss

- Loss of volatile storage
  - It can recover using various techniques.
  - Ex:- log based recovery, backup management, check point and shadow paging techniques.

- Non-volatile storage loss
  - I can dump the Data base to a suitable storage.

Dump :-

- Dump means it provides the garbage value
- There are various techniques to remove after recovery.

- Ex:- (i) cascading roll back
- (ii) Recoverable scheduler.

- cascading roll back :-

The process in which a single transaction failure leads to a series of transaction is roll back is known as cascading roll back.

Ex:-

	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Read(x)			
Read(y)			
$Z = x + y$		Read(z)	
Write(z)		Write(z)	



- The transaction  $T_1$  wrote a value of 'z' i.e., read by transaction  $T_2$ ,  $T_2$  wrote a value of 'z' i.e., read by transaction  $T_3$ .
- Suppose at that point  $T_1$  phase,  $T_1$  must be roll back.  $T_2$  is depend upon  $T_1$ ,  $T_2$  must be roll back. since  $T_3$  is depend upon  $T_2$ ,  $T_3$  also be roll back.

## (ii) Recoverable scheduler:-

$T_1$	$T_2$
Read (x)	
Write (x)	
	Read (x)
Read (y)	

- In this transaction  $T_2$  performs one transaction i.e Read (x).
- suppose the system allow  $T_2$  to commit immediately after excluding the read (x) instruction.
- It means  $T_2$  commits before  $T_1$  terminates.

## Log Based Recovery :-

- The data base management system maintains a special record, known as log files, that contains information about all update.
- The log files contains information like transaction identity, type of log records.
- In the past, the log files are stored on the magnetic tapes but now today the log files are stored in storage device.
- If generated during software installation are created by web server.

Q3: What is log file?

Ans:- It is a file that contains a list of events which have been logged by a computer.

Check point:-

- Check point is also known as save point.
- It is a point of synchronisation between the D.B & the transaction log files.

Backup mechanism:-

- The backup copy of the D.B can be used to recover the D.B in the event that the D.B has been damaged or destroyed.

Shadow Paging:-

- This technique does not require the use of a log file in a single user environment, a log is needed in a multi-user environment for concurrency control.
- Shadow paging considers the D/B to be made up of a number of fixed size disk page blocks for recovery purposes.

Deadlock:-

- When a process requests a resource if the resource are not available at that time, the process enters to the waiting state.
- Some time a waiting process is never able to change its state because the resources it has requested are held by other waiting processes.



- This situation is called as deadlock.
- A process must request a resource before use it and release the resource after using it.
  - It is of three types

- (i) Request :-
- (ii) Use :-
- (iii) Release :-

- (i) Request :- The process request the resource if the request can not be granted immediately then the requesting process must wait until the resource is free.
- (ii) Use :- The process can operate the resource.
- (iii) Release :- The process release the resource.

Deadlock characteristics / Deadlock characterization

The deadlock characterization is of four types

- (i) Mutual Exclusion :- At least one resource must be held in a non-sharable mode. Only one process at a time can use the resource.
  - If another process request that resource the requesting process must be delayed until the resource has been released.
- (ii) Hold & Wait :- A process must be holding at least one resource and waiting to other additional resource that are currently being held by other process.
- (iii) No-preemption :- Resource can be released only by the process holding it, after that process has completed its task.

(iv) Circular Wait: A set  $\{P_0, P_1, P_2, \dots, P_n\}$  & waiting process must exist such that  $P_0$  waiting for a resource that is held by  $P_1$ ,  $P_1$  waiting for a resource that is held by  $P_2$ , ...  $P_{n-1}$  wait for a resource that is held by  $P_n$  and  $P_n$  waiting for a resource that is held by  $P_0$ .

### Methods for Handling Deadlock :-

A system enters a deadlock state when a set of transaction, every transaction is waiting for another transaction to finish its operation.

→ There are two methods are used for handling the deadlock.

(1) Deadlock prevention protocol

(2) Deadlock detection & recovery process

(1) Deadlock prevention protocol:

If the system will not go into deadlock state there are different methods are used for deadlock prevention.

(i) Simplest schema requires that each transaction locks all its data item before it starts the execution.

(ii) Another method for preventing the deadlock is to impose the partial ordering of all data items and require that a transaction can lock a data item only in the order specified by the database administrator.

(iii) Another approach for prevention of deadlock to impose transaction roll back

(2) Deadlock detection & recovery process :-  
If a system does not imply some protocols that ensure deadlock freedom. Then a detection and recovery schema must be applied.

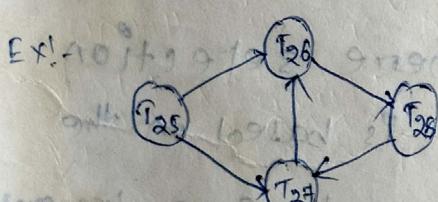
Q What is protocol?

Protocol means it is a set of rules and regulation.

### Deadlock Detection :-

Deadlock can be described in terms of a directed graph called as wait for graph.

- The graph is denoted as 'G'.
- This graph consists of a pair  $G = (V, E)$  where  $V$  = vertices,  $E$  = edge.
- Each element in the set  $E$  of edge is an ordered pair  $T_i \rightarrow T_j$ .
- If  $T_i \rightarrow T_j$  is in  $E$  there is a directed edge from transaction  $T_i$  to  $T_j$ .
- The transaction  $T_i$  is waiting for a transaction  $T_j$  to release the data items that it needed.
- A deadlock exists from the system if & only if the wait for graph contains a cycle.
- Each transaction involved in the cycle is called as deadlock.



In the above example  $T_{25}$ ,  $T_{26}$  &  $T_{27}$  are the deadlock

Recovery from Deadlock:

When a detection algorithm determines a deadlock is exist in the system must recover from the deadlock.

- the most common solution is to roll back one or more transaction to break the deadlock.
- There are three steps are used for recovery from deadlock

(i) selection of victim

(ii) Roll back

(iii) starvation

(i) selection of victim:-

In this we determine which transaction is roll back to break the deadlock. We should roll back those transaction which is the minimus cost.

(ii) Roll back:-

Once we have decided a particular transaction must be roll back, then we determine how this transaction should be roll back.

→ The common solution is total roll back.

(iii) starvation

In a system where selection of transaction for roll back is based on the cost factor. It may happen that some transaction are always picked up.

→ In starvation we can find out the highest & lowest cost of the transaction

→ After finding the highest & lowest cost the database administration provides specific range of the cost those transaction are exceeds the cost these are not rollback otherwise it is rollback.

QMP

## Data Base Failure & Types of Failure's

Data base failure means it is loss of data or information of the data base.

- The failure occurs different reasons that may be hardware & software.
- There are seven types of database failure are present.

(i) statement failure

(ii) User process failure

(iii) Network failure

(iv) Instance failure

(v) User error

(vi) Media failure

(vii) Software failure

(i) Statement failure's

When a programme attempt to enter invalid data into an oracle table.

→ There is no more room to put the data in.

→ Not having the proper privilege to perform a task.

(ii) User process failure:-  
A user process may be terminated unexpectedly.

(iii) Network failures:-

- Network connection has failed (Server)
- Network interface card is failed (LAN)
- Network supporting software fail (OS)

(iv) Instance failures:-

- Hardware failure
- Software failure
- Power failure
- An emergency shutdown procedure.
- Oracle background process shutdown because of an error condition.

(v) User Errors:-

- Dropping a table.
- Modify or delete data from a table.

(vi) Media failures:-

- Disk controller fails
- Loss of disk
- File corruption
- The deletion of data file from the disk.

### (vii) Software Failure:-

System software & application software fails.

- Software crash.
- Resulting data not being saved.
- Data corruption such as file system corruption or database corruption.

### Q What is System software?

System software is a computer software design to operate & control the hardware to provide a platform to running the application of software.

### Application Software:-

- Android application
- Oracle 10g
- MS office

### Q Concurrency Control:-

Concurrency control is the process of managing multiple operations on the data base without having the interference with one another.

- The objective of concurrency control is similar to the objective of multiuser computer system or multiuser programming system.
- Where many user can perform different operation at the same time.

→ In this system the different users are allowed to perform different action at same time due to the concept of multiprogramming.

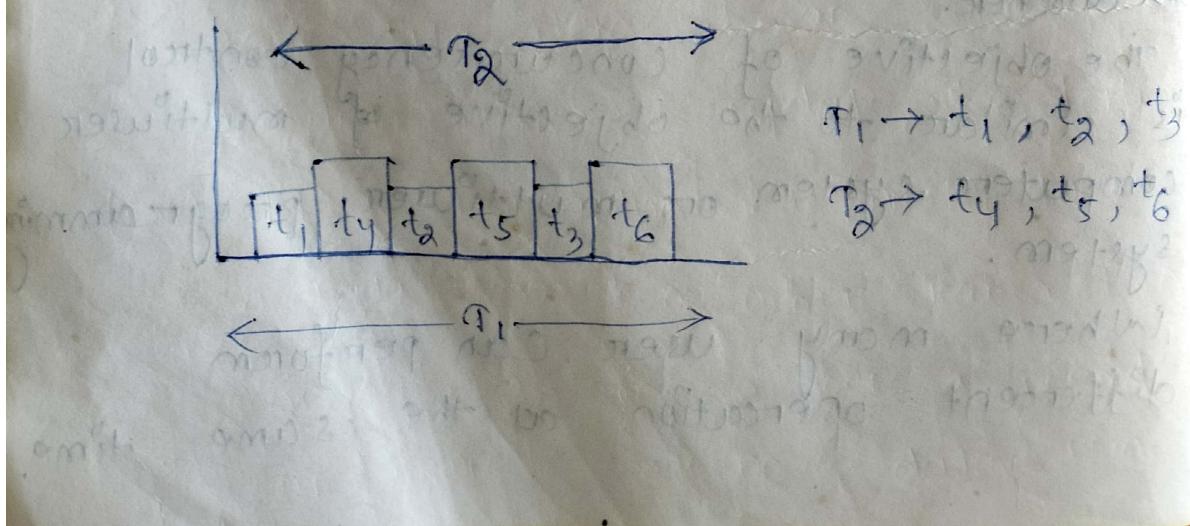
→ Whenever we are using the concurrence control it creates three major problems

- (1) Lost update problem
- (2) Dirty read problem
- (3) Incorrect read problem

→ Whenever two update operation are executing at the same time various steps of individual operation perform like

$T_1$	$T_2$
1. Read X	Read X
2. $X = X + 5$	$X = X * 2$
3. Write X	Write X

→ Whenever the update operation are executing at the same time the individual steps of update operation are executed one after another by switching over between the various steps.



- During the sequence of operation the update value of  $x$  in  $T_1$  is modified by  $T_2$  so that whenever step 3 of  $T_1$  happens the modified value of  $x$  in  $T_1$  is not present. Hence it is called as lost update problem.
- Whenever a lot of temporary values or intermediate value are created during update operation. This intermediate value are known as dirty values.
- Whenever there is an attempt to read this dirty values which are not used then the process is called as dirty read problem.
- Every operation acts the intermediate value with a separate variable. For storing the intermediate values, the intermediate values do not affect the update operation between sum operation.
- In this way the total sum is changed. This problem is called as incorrect read problem.

# Locking Techniques for concurrency control

LOCKING is a procedure to control concurrent access of data.

- When one transaction is accessing in the data base a lock may be deny access to other transaction to prevent incorrect result.
- A transaction must obtain read or write lock on a data items before it can perform a read or write operation.
- There are four basic rules are applied in the locking. They are (i) If a transaction has a read lock on a data item it can read the data item but not update it.  
(ii) If a transaction has a read lock on a data item other transaction can obtain a read lock on data item but not write lock.  
(iii) If a transaction has write lock on a data item it can both read the data item & update the data item.  
(iv) If a transaction has write lock on a data item then other transaction can not obtain either a read or a write lock on a data item.

## Mode of Locking

There are mainly two mode of a data items are present. They are

(1) Shared lock

(2) Exclusive lock

### (1) Shared lock

If a transaction  $T_1$  has obtained a shared lock on a data item  $Q$  then  $T_1$  can read the data item  $Q$  but can not write the data item  $Q$ .

### (2) Exclusive lock

If a transaction  $T_2$  obtain a exclusive lock on a data item  $Q$ , then  $T_2$  can both read the data item and write the data item  $Q_2$ .

## Two phase locking Protocol

The two phase locking protocol required that each transaction uses lock & unlock requests.

→ Two phase locking protocol uses two phases

(i) Growing phase

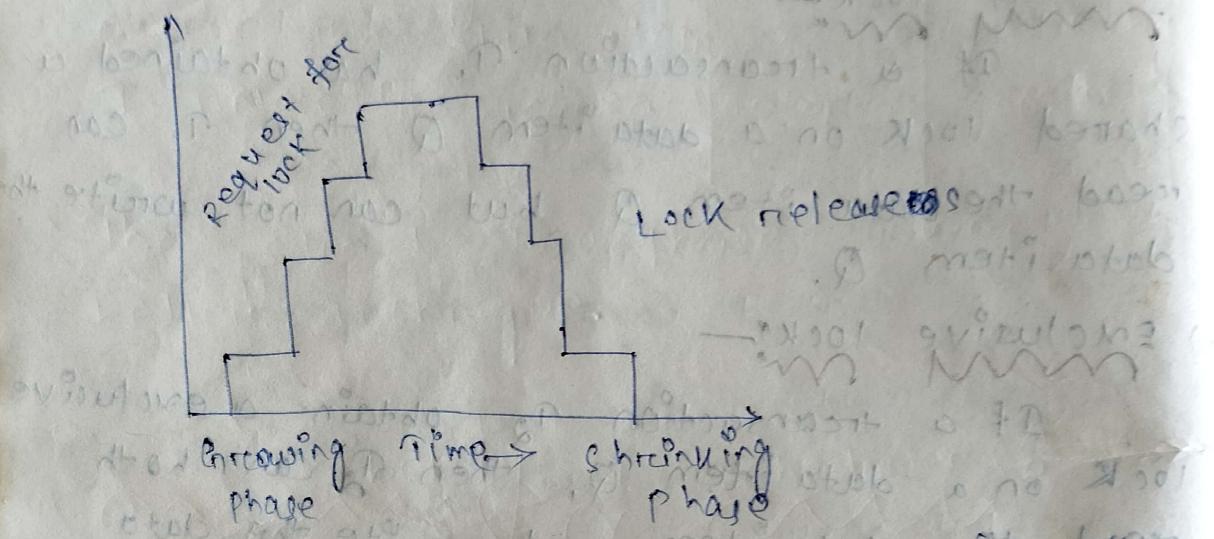
(ii) Undeblocking phase

(i) Growing phase → In this phase a transaction may obtain locks but may not release any lock.

→ Hence the no. of locks increases from zero to the maximum for the transaction.

(2) Shrinking Phase - In this phase a transaction may release the locks but may not obtain the new locks.

→ Hence the no. of locks decreases from maximum to zero.



The shrinking phase is divided into three types

(i) static two phase locking

(ii) dynamic two phase locking

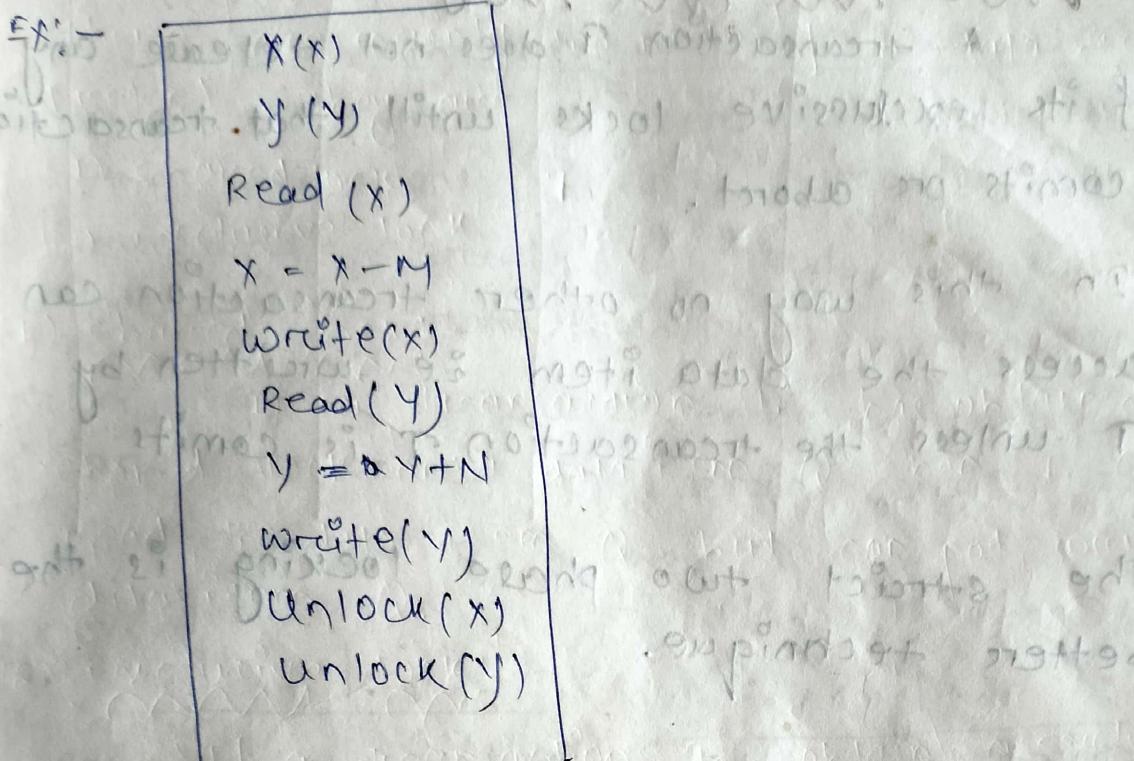
(iii) strict two phase locking

(i) static two phase locking -

In static two phase locking all the data items are locked before any operation on them & are released only after the last operation is performed on the data item.

→ In static two phase locking request from other transaction for data item

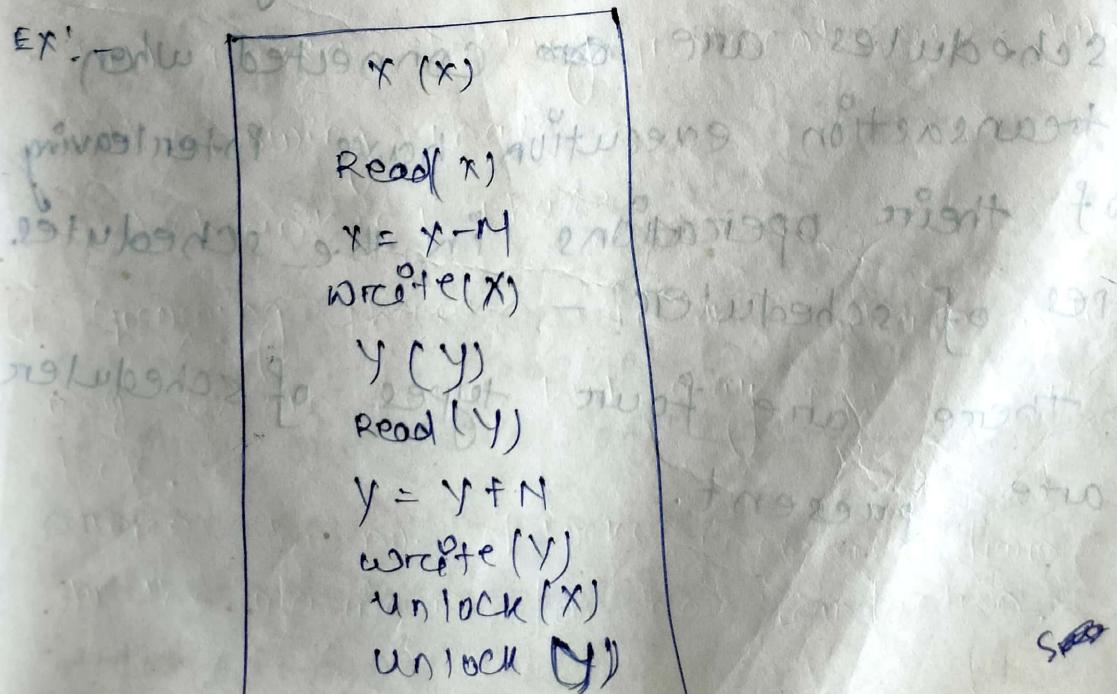
locked by the previous transaction will be delayed.



### (ii) Dynamic Two Phase Locking

In dynamic two phase locking a transaction lock a data item immediately before any operation is applied on the data item.

→ After finishing all the operation on all data items it release all the locks.



Ans



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(iii) Strict two phase locking -  
A transaction T does not release any of its exclusive locks until that transaction commits or aborts.

- In this way no other transaction can access the data item i.e. written by T unless the transaction T is commits
- \* The strict two phase locking is the better technique.

## Serializability of Schedules

When several transaction are executing concurrently then the order of execution of various instruction is called as scheduler.  
The concept of serializability of scheduler is used to identify which schedules are connected when transaction execution have interleaving of their operations in the schedules.

### Types of scheduler -

→ There are four types of scheduler are present.

## (1) Serial schedules:-

Suppose there are two schedules A and B called as serial schedules if the operations of each transaction are executed serially without any interleaved operations from the other transaction.

→ In serial schedules entire transactions are performed in serial order e.g.  
 $T_1$ , then  $T_2$  or  $T_2$  then  $T_1$ .

$T_1$	$T_2$	$T_1$	$T_2$
Read-item(X); $X = X - N;$ write-item(X);			Read-item(X); $X = X + M;$ write-item(X);
Read-item(Y); $Y = Y + N;$ write-item(Y);		Read-item(X); $X = X + N;$ write-item(X);	Read-item(Y); $Y = Y + M;$ write-item(Y);
(Schedule - A)			(Schedule - B)

## (2) Non-serial schedules:-

Suppose there are two schedules C & D are called as non-serial schedule if the operation of each transaction are executed non-serially with interleaved operation from other transaction.

Ex! - T <sub>1</sub>	T <sub>2</sub>	T <sub>1</sub>	T <sub>2</sub>
Read-item(x);	Read-item(x)	lasted	1 - base
$x = x - N;$	$x = x + M;$	initial	end
Write-item(x);	Write-item(x)	between	base
Read-item(y);		last	initial
$y = 2y + M;$		initial	end
Write-item(y);		last	initial

### (3) Conflict schedules

The graph which contain no cycle is called as conflict schedules.

### (4) View schedules

A schedule is said to be view schedules if it is view to the equivalent of some serial schedules.

In view schedules it is viewed by the data base administrator and the data base users are not view it.

Imp Time stamp ordering / Time stamp based Sched

A stamp is a unique no. allocated to a transaction for determining the order in which the transaction has come to the system.

- Whenever this technique is used there is no possibility of dead lock. Because a predefined technique is used to determine which transaction is to be used at a specific time.
- The value of time stamp for a single data item can be taken as a counter which implement every time stamping as one.
- The basic operation on time stamp of a given data item are
  - (1) Read  $T_s(x)$ : - Read time stamp of  $x$
  - (2) Write  $T_s(x)$ : - Write time stamp of  $x$
- Whenever two transactions are trying to access the same data item then according to the time stamp of transaction we decided which one is older & which one is new.
- If the older one is performing on the database then the new one must be aborted.
- similarly whenever the new one is performing on the database then the older one may have to wait.
- There are two techniques are used
  - (i) Wait differencing
  - (ii) Round robin

(i) Wait die:— Whenever older transaction is already performing on the data base then the new transaction has two option if wait or abort die.

(ii) Wound die:— Whenever a new transaction is performing then the older transaction has two option if either forcefully update the data base (wound) or wait.

### Multiversion Concurrency control technique

This technique is used for performing multiple transaction on the data base at the same time.

- It can generate the intermediate value of a single data item are stored in a permanent memory in different area called as version of the data item.
- In this technique a lot of version of the data item are stored so that each version can be allocated to separate transaction.
- According to this the various version are used for different categories of the transaction.
- It is divided into two type

(1) Multiversion concurrency control using time stamp ordering

(2) Multiversion concurrency control using lock

## Recovery Techniques:-

In recovery technique it uses a transaction

log.

- A transaction log is a record in database management system that keep track all the transaction.
- It helps in which transaction did which changes.
- After changes the system knows how to separate the changes made by transaction that have committed & those changes that did not yet commit.
- In recovery technique it uses the concept of REDO or UNDO.
- The selection of REDO or UNDO is done on the basis of the transaction. If the transaction commits it uses REDO if not commits it uses UNDO.
- It provides inconsistency state to a consistent state.
- It uses the concept of check point.
- Check point transfers all the committed changes to the data base and all the system logs to a stable storage.
- There are four recovery techniques are used. They are
  - (i) Deferred update (NO-UNDO/REDO)
  - (ii) Immediate update (UNDO/REDO)
  - (iii) Immediate update (UNDO/NO-REDO)
  - (iv) shadow paging (NO-UNDO/NO-REDO)

## (i) Deferred update (NO-UNDO/FREDO):

This technique is actually updating of the database on disk until a transaction reaches its commit point.

- The transaction first writes the log to disk before recording the updating data base.
- In deferred update there is no possibility of transaction roll back.

## (ii) Immediate update (UNDO/FREDO):

This technique may apply changes to the data base on a disk before the transaction reaches a successful conclusion.

- Any changes applied to the data base first recorded on log and written to disk so that these can be done if necessary.

## (iii) Immediate update (UNDO/NO-FREDO):

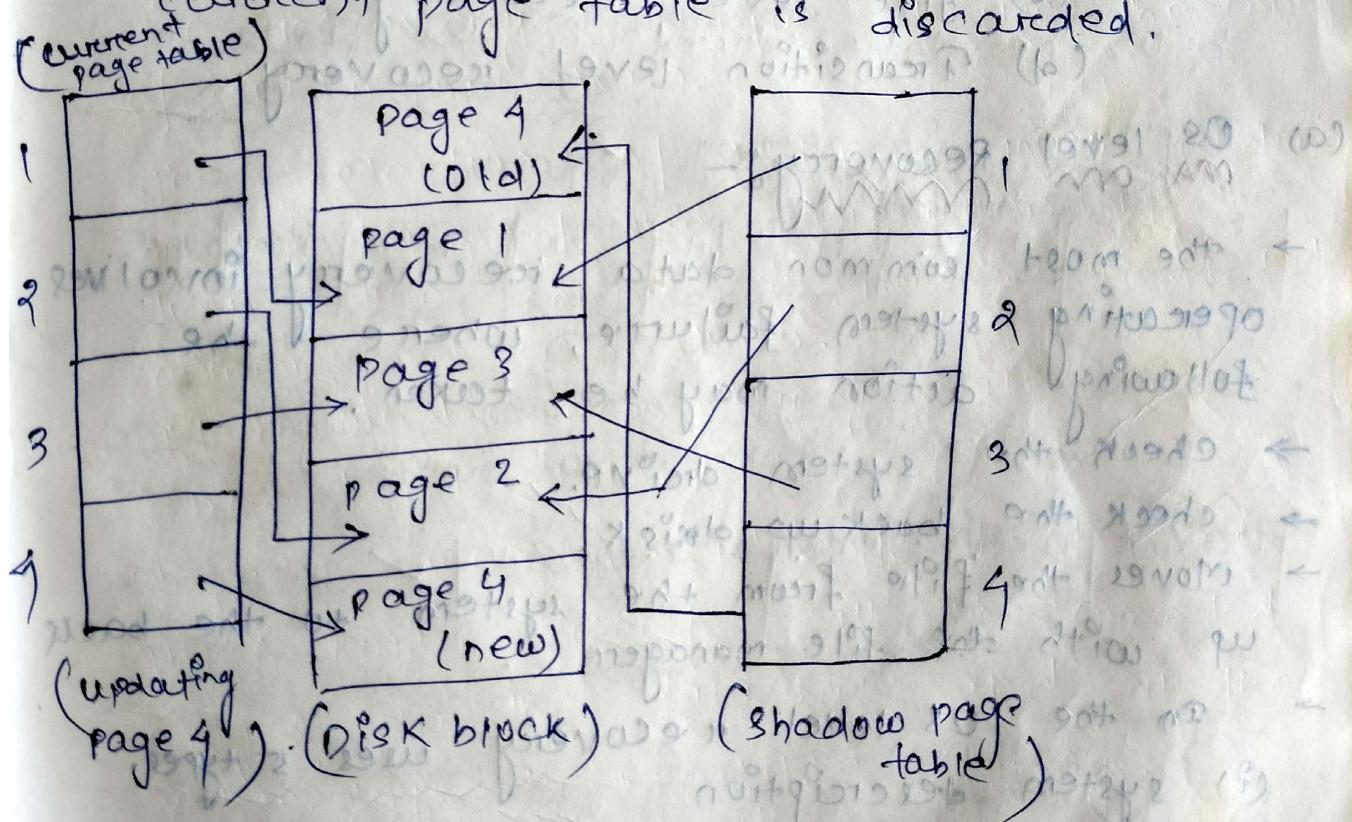
This technique applies all transaction actions are recorded in the database before committing. Commit.

## (iv) Shadow Paging (NO-UNDO/NO-FREDO)

This does not require the use of transaction log.

- It consider the data base to be made of a fixed size disk pages.
- It constructed a table.
- Two page tables are not maintained during the life of a transaction.

- It uses the current page table & the shadow page table.
- The current page table & shadow page table never change during the transaction.
- When the transaction is partially committed the shadow page table is discarded and current page table becomes shadow page table.
- If the transaction abort then the current page table is discarded.



## Data base Recovery and Different types of Recovery

- It is a process of solving the data items from damage, failed, corrupted.
- The data item is being solve from storage media format such as hard disk, CD, DVD.
- A computer system play an important role for creating, updating, storing & sharing the information in a DB.
- There are four types of recovery process. They are
  - (a) OS level recovery
  - (b) Disk level recovery
  - (c) file level recovery
  - (d) Transaction level recovery

### (a) OS level Recovery:-

- the most common data recovery involve operating system failure, where the following action may be taken.
  - check the system drive.
  - check the back up disk.
  - move the file from the system to the back up with the file manager.
  - In the OS level recovery we have 5 types:
    - (i) system description
    - (ii) Boot sector
    - (iii) partition layout
    - (iv) file metadata
    - (v) system metadata

### (i) System Description:-

System specification are needed to produce a exact replacement after a disaster.

### (ii) Boot sector:-

The boot sector can sometimes recreated more easily than saving it.

### (iii) Partition layout:-

The layout of original disk as well as partition table and file system setting is needed to properly recreate the original system.

### (iv) File meta data:-

It can restore to properly recreate the original environment.

### (v) System meta data:-

System operating system of different procedure to storing the information.

### (b) Disk level Recovery:-

→ A wide variety of failure can uses physical damage to storage media.

→ Physical damage always lost some data item.

→ Most physical damage can't be repaired by end user.

→ End users are generally don't have the hardware people or technical expert, require to make these repair.