

Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Second Year)

Subject: Computer Science

Course Code: CSC103

Course Title: Database Management systems

Unit: 09

Module Name: Transaction Management: Deadlocks

Notes:

Introduction

- A deadlock is an unwanted situation in which two or more transactions are waiting indefinitely for one another to give up locks.
- A state where neither of the transactions can ever proceed with its normal execution. This situation is called deadlock.
- 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.

Example of Deadlock:-

- Transaction T1 holds a lock on some rows on student table 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 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; this situation is known as deadlock.

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.
- Aborting or restarting the system again 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.

Deadlock Detection

- In a database, when a transaction waits indefinitely to obtain a lock, the DBMS should detect whether the transaction is involved in a deadlock or not.
- The deadlock can be detected by the resource scheduler who checks all the resources allocated to the different processes.
- One of the methods for detecting deadlock is Wait-For-Graph which is suitable for smaller databases.
- The handling of deadlock is costly and it is better if we can prevent it rather than handling it.

Deadlock Detection Method

➤ Wait For Graph

- This is one of the methods for detecting the deadlock situation.
- 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.
- This method is suitable for smaller databases.

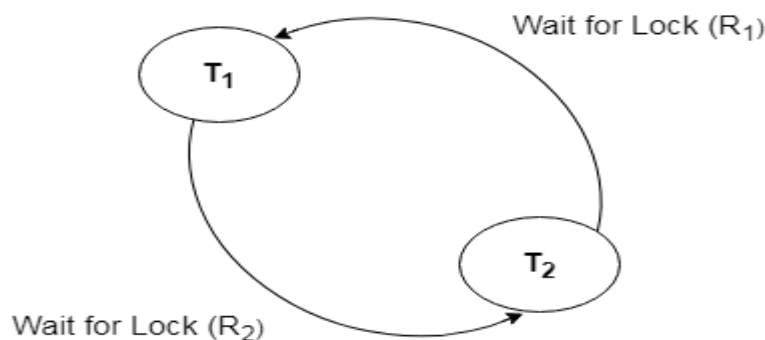


Fig 1: Deadlock Situation

Deadlock Prevention

- Deadlock prevention method is suitable for a large database.
- A deadlock can be prevented if the resources are allocated in such a way that deadlock never occurs.
- The Database management system analyses the operations of the transaction whether they can create a deadlock situation or not.
- If the operations of transaction creates deadlock, then the DBMS never allows that transaction to be executed.
- Wait-Die scheme, Wound wait scheme are two methods which are used to prevent deadlocks.

➤ 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 two transactions T_i and T_j and let $TS(T)$ is a timestamp of any transaction T .
- If T_j holds a lock by some other transaction and T_i is requesting for resources held by T_j then certain actions are performed by DBMS.
- Following are the actions being performed on Transactions:
- Check if $TS(T_i) < TS(T_j)$ - If T_i is the older transaction and T_j has held some resource, then T_i 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.
- Secondly, Check if $TS(T_i) < TS(T_j)$ - If T_i is older transaction and has held some resource and if T_j is waiting for it, then T_j 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.

Recovery from Deadlock

- When a detection algorithm determines that a deadlock exists, the system must recover from the deadlock.
- The most common solution is to roll back one or more transactions to break the deadlock.
- Choosing which transaction to abort is known as Victim Selection.
- Deadlock recovery is generally used when deadlocks are rare and the cost of recovery is low.

Methods for Recovery

1. Termination of processes

- Killing all the processes involved in the deadlock.
- Killing process one by one. After killing each process check for deadlock again keep repeating the process till the system recovers from deadlock.
- Killing all the processes one by one helps a system to break circular wait condition.
- In other words, some victim process is chosen for termination from the cycle of deadlocked processes.
- This process is terminated, requiring a later restart
- All the resources allocated to this processes are released, so that they may be reassigned to other deadlocked processes

- With an appropriately chosen victim process, this should resolve the deadlock.

Summary:

- A deadlock is an undesirable situation in which two or more transactions are waiting indefinitely for one another to give up locks.
- In deadlock, all activities come to a halt state and remain at a standstill.
- 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.