DATA AND WEB DEVELOPMENT

[CC6012NP]

WEEK - 05

Database Concurrency II

Earlier Lecture

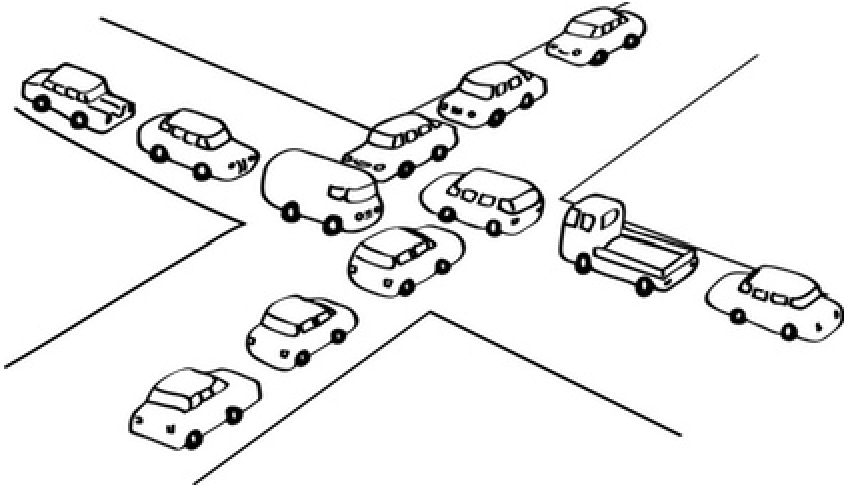
Concurrency can be managed by adding LOCKS to the table

Deadlock - Definition

A system is in a state of deadlock if there exists a set of transactions such that every transaction in the set is waiting for another transaction in the set.

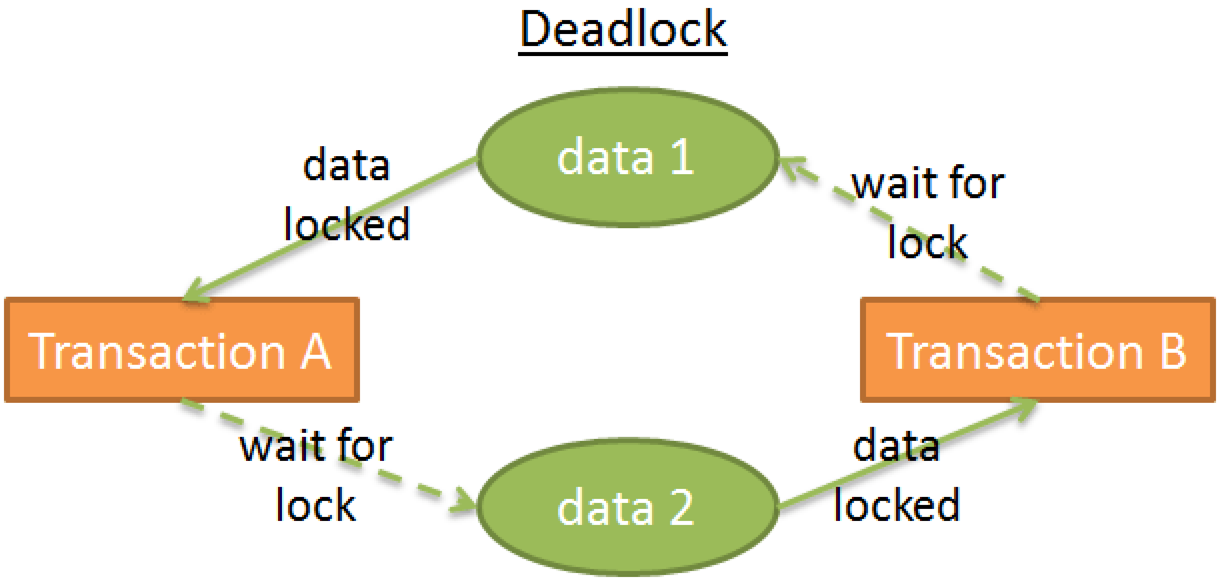
Deadlock - Definition

Deadlock is a situation in which two or more transactions are in a simultaneous ***wait*** state, each of them waiting for one of the others to release a lock before it can proceed

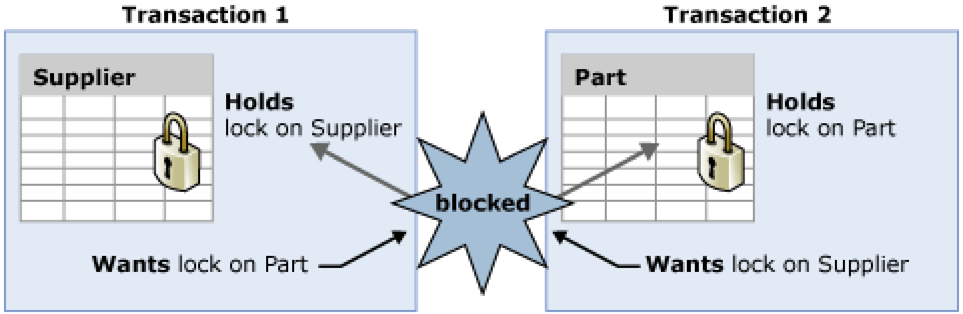


Database Concurrency – A Situation Likely to Occur

Deadlock

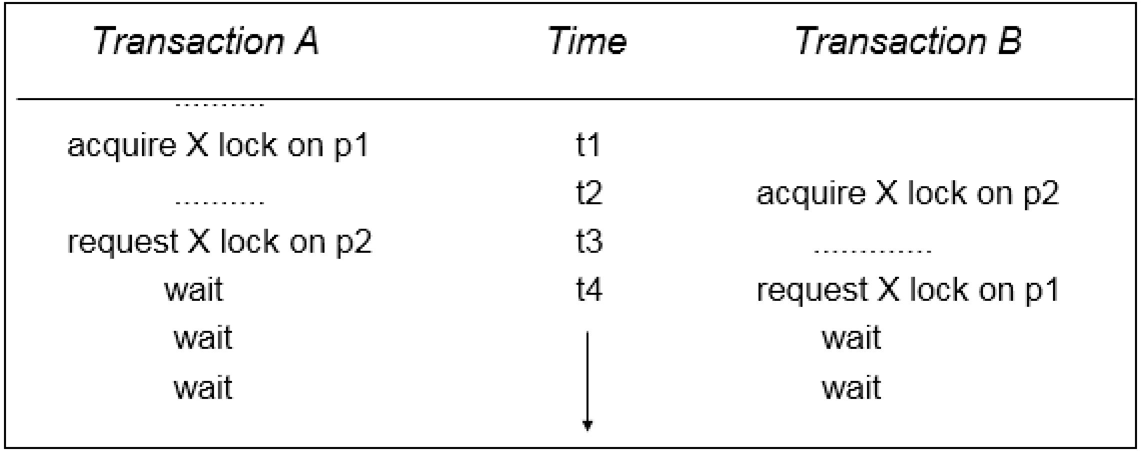

Deadlock
data 1
data locked
wait for lock
Transaction A
Transaction B
wait for lock
data 2
data locked

Deadlock



- □ They hold locks that may be required by other transactions
- □ DBMS must either PREVENT or DETECT and RESOLVE deadlock

Deadlock Problem - Example



Transaction A	*Time*	*Transaction B*
....		
acquire X lock on p1	t1	
....	t2	acquire X lock on p2
request X lock on p2	t3	....
wait	t4	request X lock on p1
wait	↓	wait
wait		wait

Here, neither of transactions can proceed !

Handling Methods

Deadlock Prevention

- Prevents the deadlock state

Detection and Recovery

- Implements detection and recovery scheme

Handling Methods

May result in

Transaction Rollback

Processing Overhead

Deadlock Prevention Scheme

Each transaction locks **ALL** its required data items before it begins execution.

Either **ALL** data items needed are locked in one step (so the transaction can then proceed) or **NONE** are locked (to avoid locking only some of the data items needed)

Best Use Situation

This scheme could be used if the probability of the system entering a deadlock state is relatively high (e.g. for long transactions needing many locks).

Disadvantages

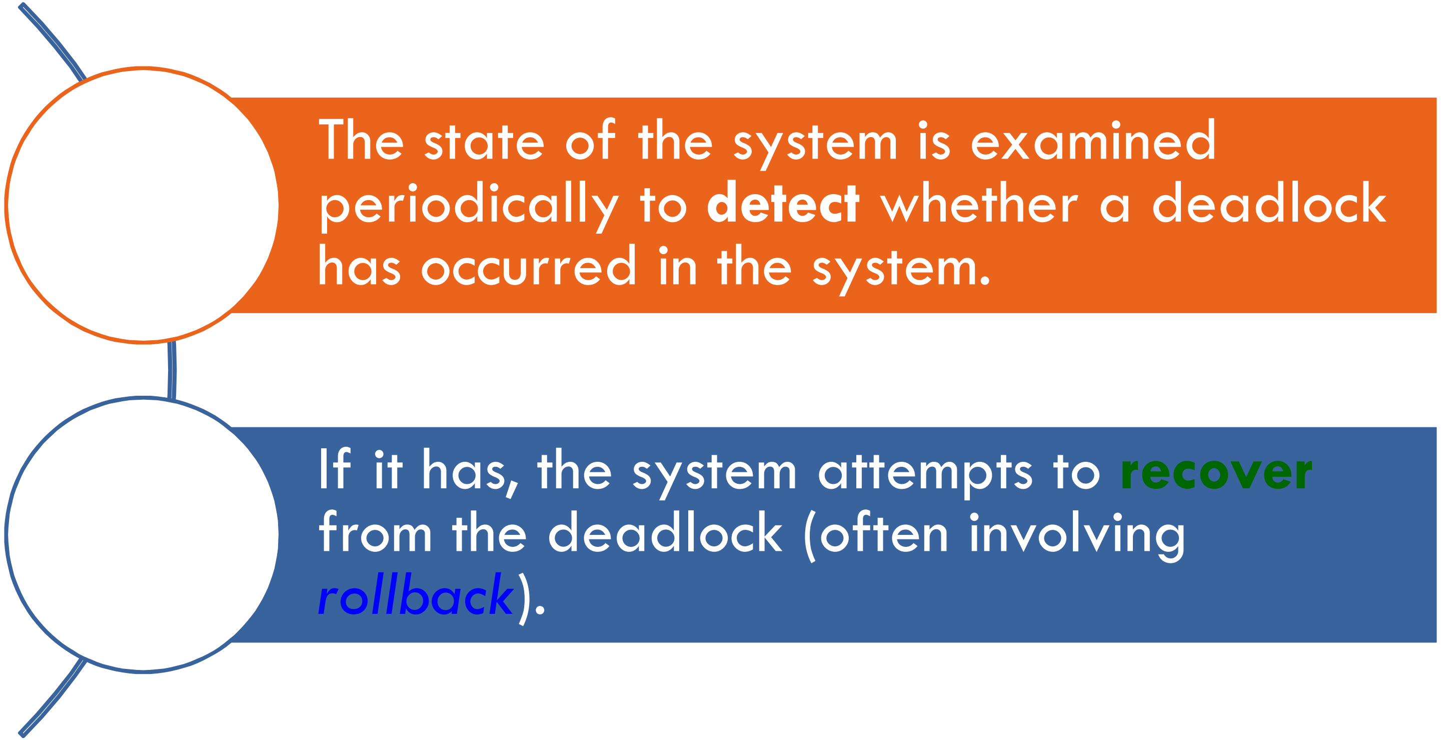
Low Data Utilization

Some data items could be locked for a long time before they are used.

Possible Starvation

A transaction which requires a number of data items may find itself in a 'indefinite' wait state while at least one of the data items is always locked by some other transactions.

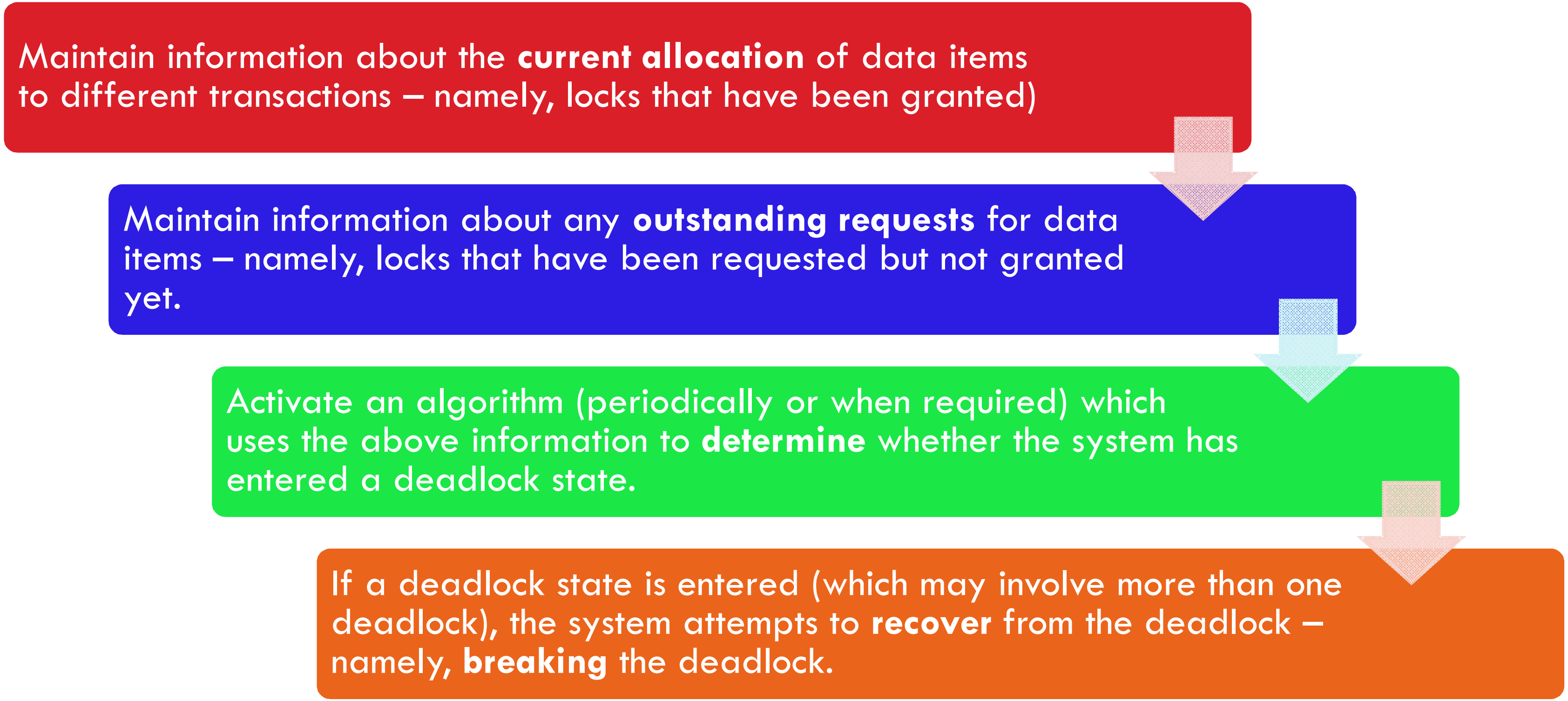
Deadlock Detection & Recovery



The state of the system is examined periodically to **detect** whether a deadlock has occurred in the system.

If it has, the system attempts to **recover** from the deadlock (often involving *rollback*).

Deadlock Detection & Recovery Process



Maintain information about the **current allocation** of data items to different transactions – namely, locks that have been granted)

Maintain information about any **outstanding requests** for data items – namely, locks that have been requested but not granted yet.

Activate an algorithm (periodically or when required) which uses the above information to **determine** whether the system has entered a deadlock state.

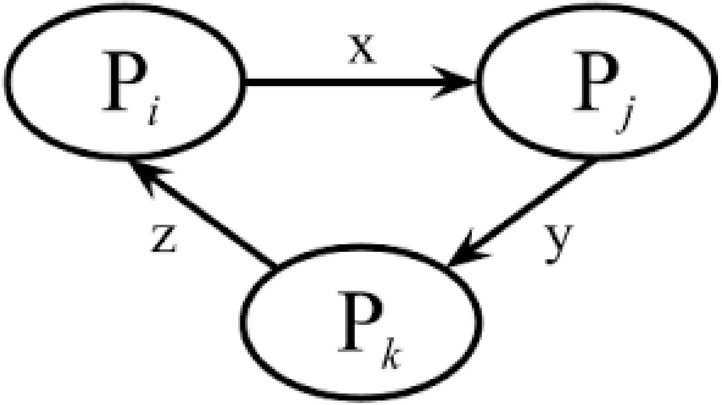
If a deadlock state is entered (which may involve more than one deadlock), the system attempts to **recover** from the deadlock – namely, **breaking** the deadlock.

Wait for Graph

- A **wait-for graph** in computer science is a directed graph used for deadlock detection in operating systems and relational database systems.
- In computer science, a system that allows concurrent operation of multiple processes and locking of resources and which does not provide mechanisms to avoid or prevent deadlock must support a mechanism to detect deadlocks and an algorithm for recovering from them.

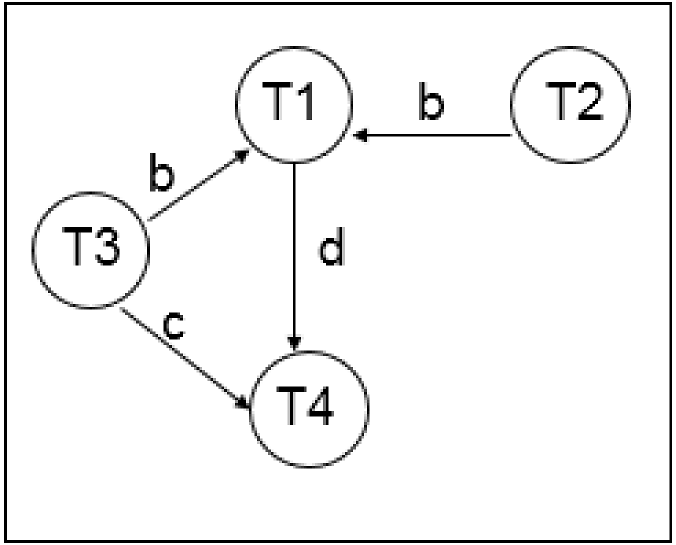
Wait for Graph

WFG is a directed graph G=(N,E) which consists of a set of nodes N and a set of directed edges E.



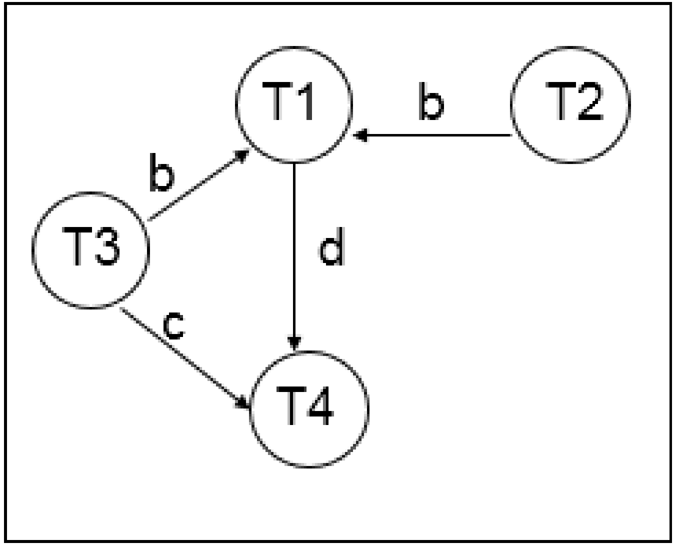
Deadlock exists if and only if WFG contains a CYCLE

Wait for Graph - Example



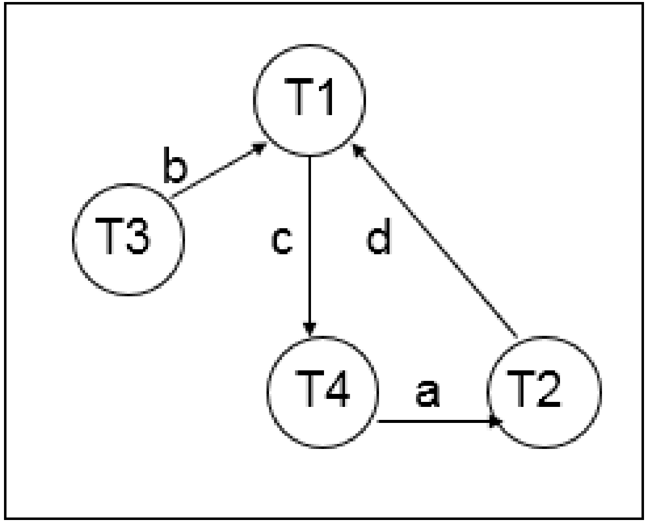
Does the above graph form a CYCLE ?

Wait for Graph - Example



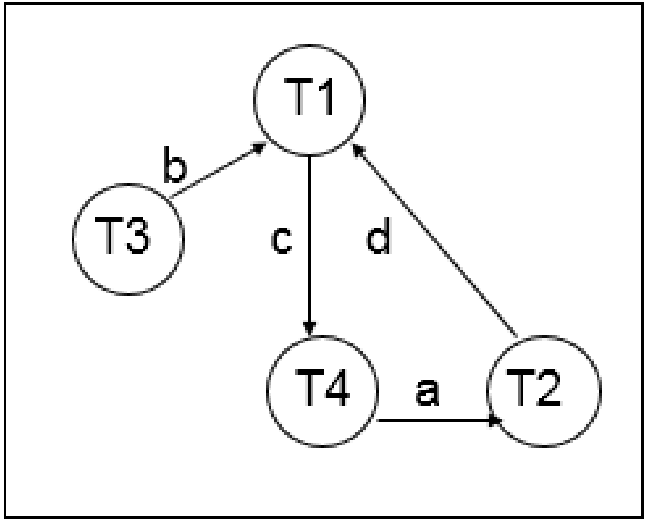
NO ! Hence, no DEADLOCK.

Wait for Graph



Does the above graph form a CYCLE ?

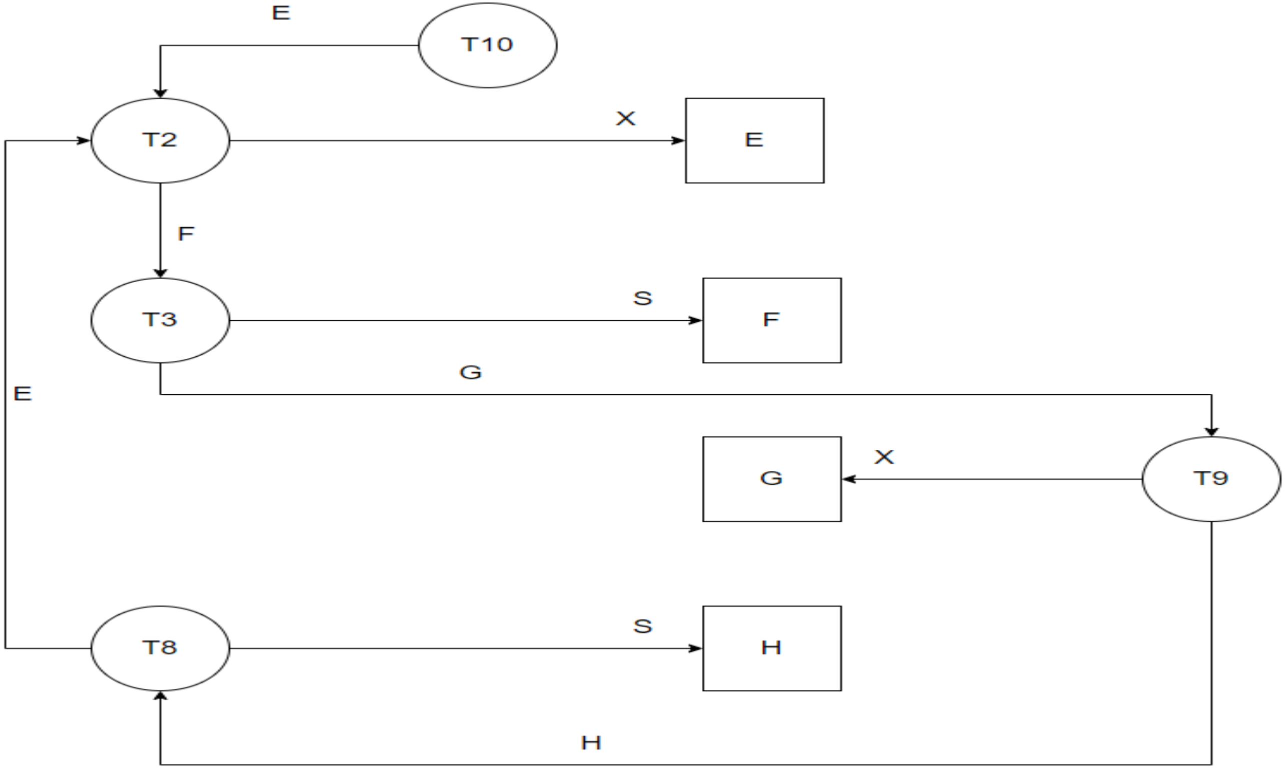
Wait for Graph



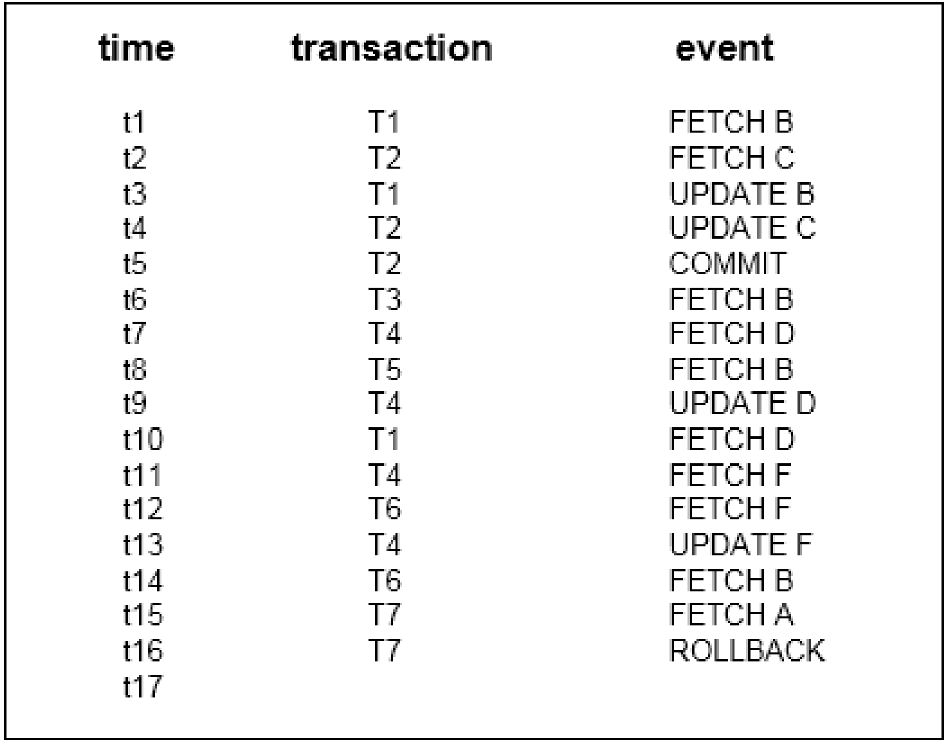
YES, T1, T4 and T2 form a CYCLE!

Hence, DEADLOCK situation.

Wait for Graph – How to Draw ?



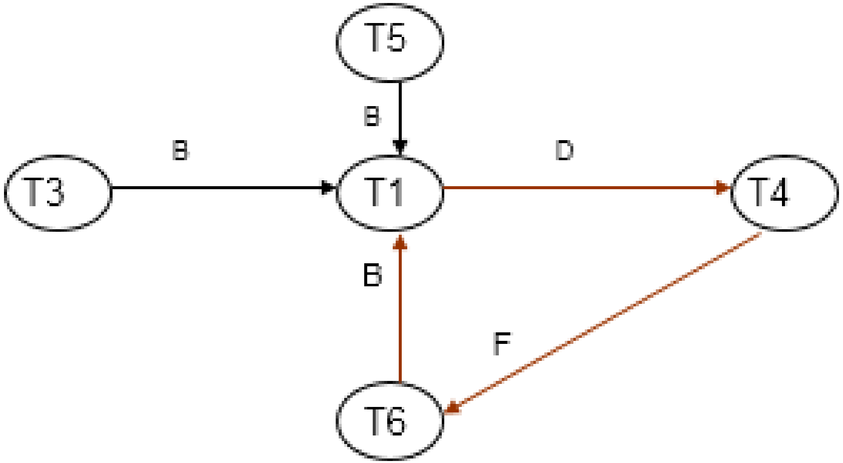
Example Worked Out



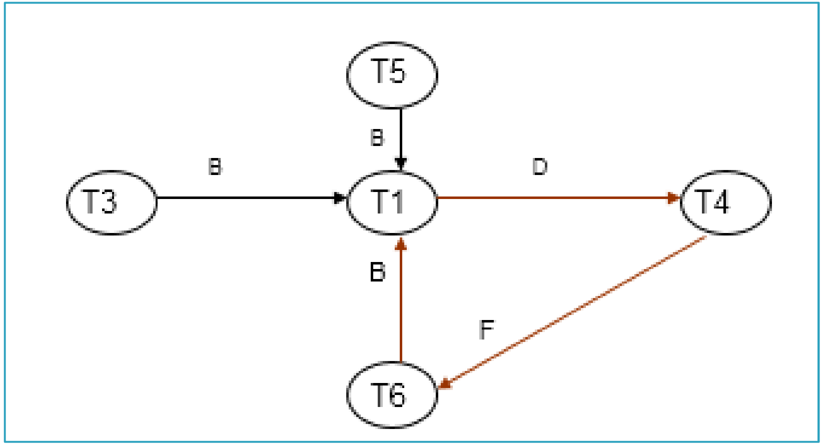
time	transaction	event
t1	T1	FETCH B
t2	T2	FETCH C
t3	T1	UPDATE B
t4	T2	UPDATE C
t5	T2	COMMIT
t6	T3	FETCH B
t7	T4	FETCH D
t8	T5	FETCH B
t9	T4	UPDATE D
t10	T1	FETCH D
t11	T4	FETCH F
t12	T6	FETCH F
t13	T4	UPDATE F
t14	T6	FETCH B
t15	T7	FETCH A
t16	T7	ROLLBACK
t17		

Provide a Wait-for-Graph to determine whether there is a deadlock at time t17, and if so, how the system could recover from the deadlock.

Wait for Graph



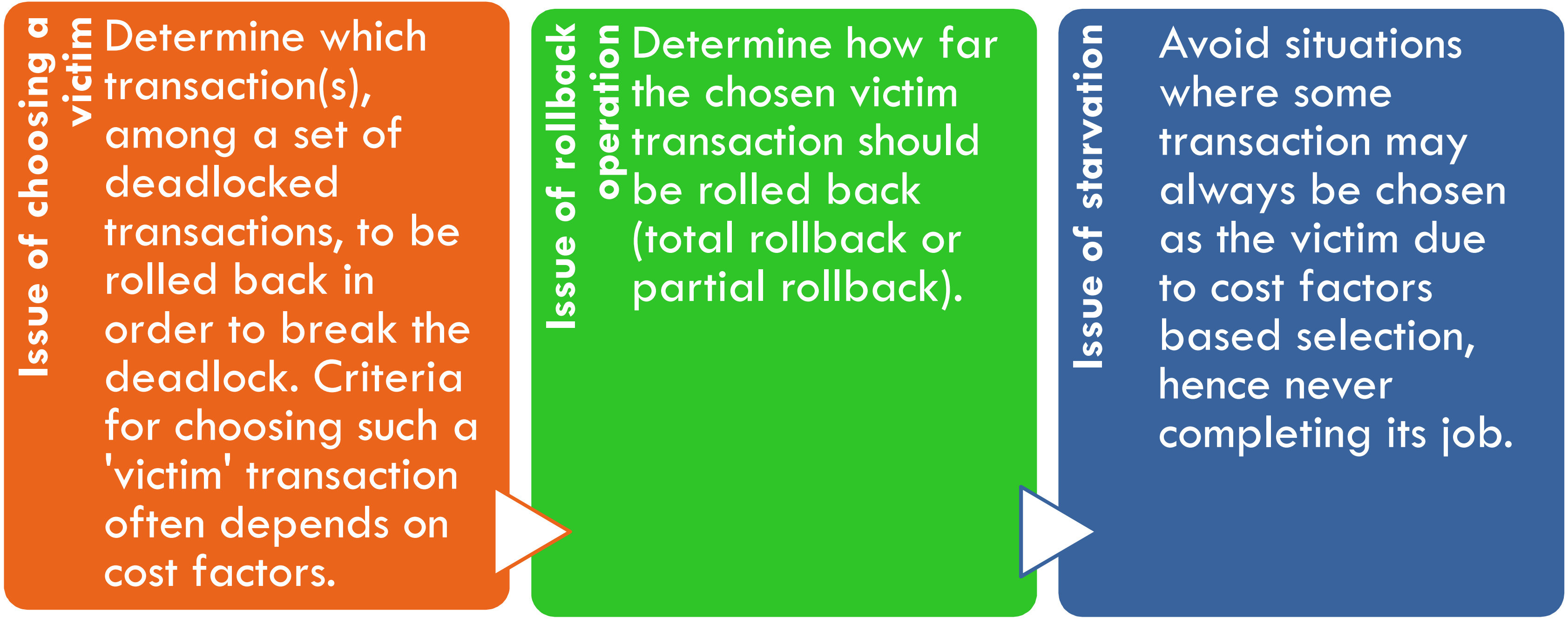
Wait for Graph



Cycle formed by T1, T6 and T4, resulting in a Deadlock

T1 waiting for T4 on D,
T4 waiting for T6 on F,
T6 waiting for T1 on B.

Deadlock Recovery - Issues



Issue of choosing a victim

Determine which transaction(s), among a set of deadlocked transactions, to be rolled back in order to break the deadlock. Criteria for choosing such a 'victim' transaction often depends on cost factors.

Issue of rollback operation

Determine how far the chosen victim transaction should be rolled back (total rollback or partial rollback).

Issue of starvation

Avoid situations where some transaction may always be chosen as the victim due to cost factors based selection, hence never completing its job.

Summary

- Concurrency Situations
- THREE types of concurrency problems
- Locking: Might result in Deadlock
- Deadlock Handling
- Wait for Graph for Deadlock Detection and Recovery

Thank You