Transaction

Chapter: 17

Topics to be Covered

- Concept of Transaction
- States of Transaction
- ACID Properties
- Problems associated with Concurrency
  - Dirty Read Problem
  - Lost Update Problem
  - Unrepeatable read problem
- **Schedule**

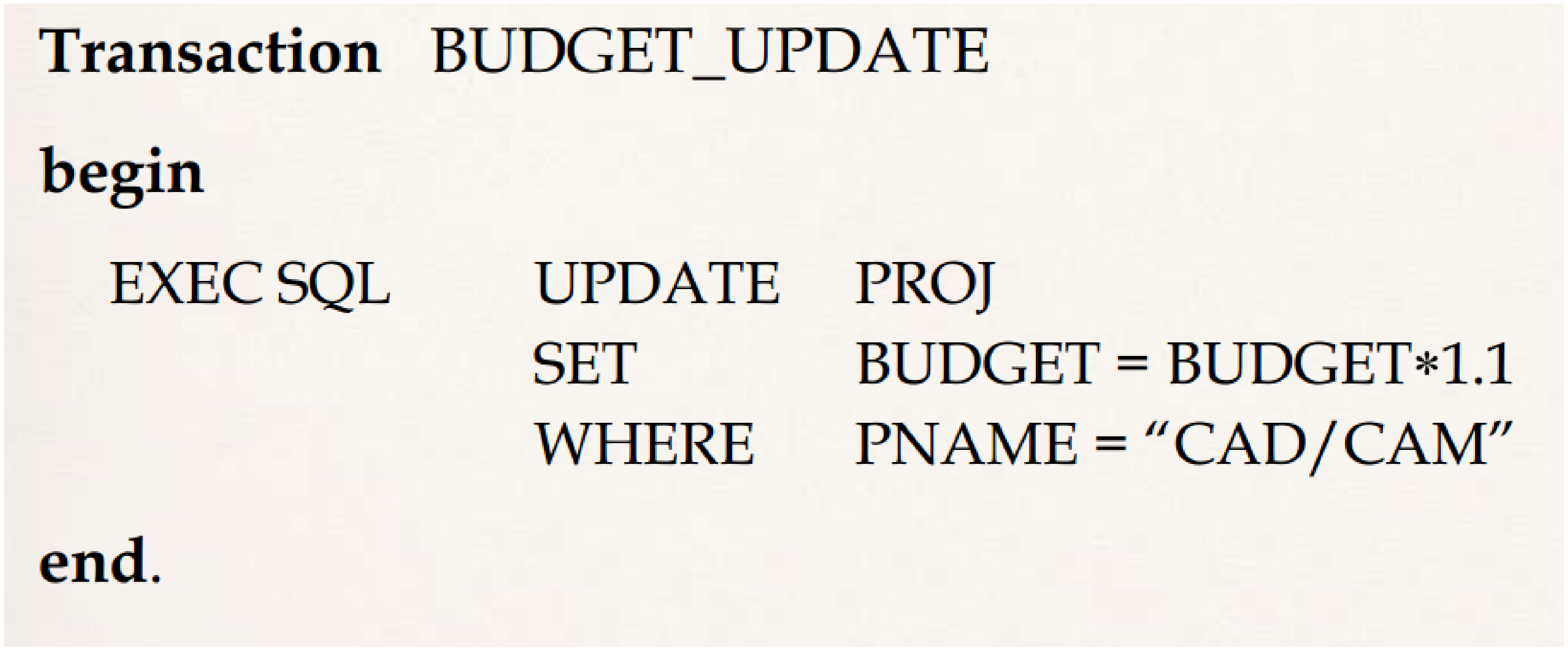
Basic of Transaction

- A Transaction is a logical unit of work.
- It is the set of operations(basically read and write) to perform unit of work,(include small units of work)
- Transaction which successfully completes its execution is said to have been committed
- otherwise the transaction is aborted or rollback

Example of Transaction

T1	T2
R(A)	
A=A+100	
	R(A)
	A=A-50
	W(A)
W(A)	
Commit(T1)	
	Commit(T2)

Example



```
Transaction   BUDGET_UPDATE
begin
    EXEC SQL        UPDATE     PROJ
                    SET        BUDGET = BUDGET*1.1
                    WHERE      PNAME = “CAD/CAM”
end.
```

Problems of Transaction and How to Solve them ??

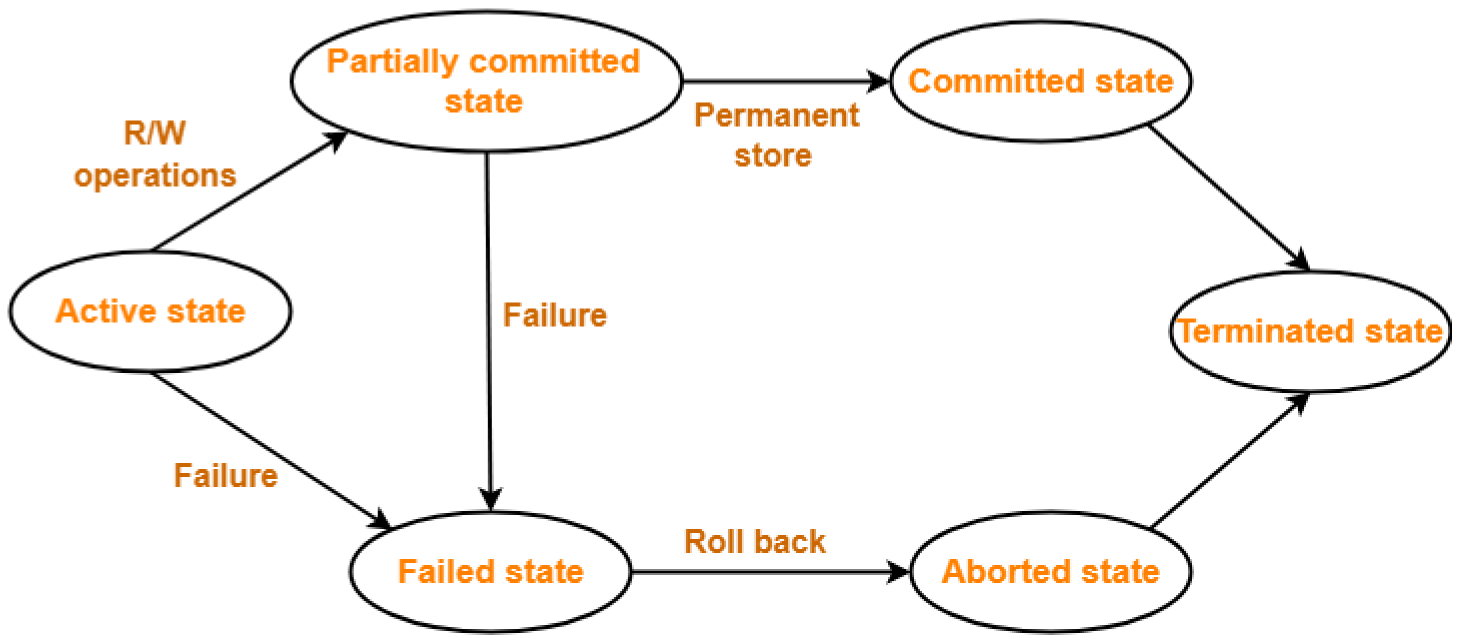
Transaction is associated with the following 3 problems :

- It may create an inconsistent results.
- It may create problems in concurrent execution.
- It may create an uncertainty to decide when to make changes permanent.

How to solve the above 3 problems ?: ACID properties

- Atomicity
- Consistency
- Isolation
- Durability
  - RAID(Redundant Array of Independent Disks)

Transaction States



Transaction States in DBMS

Advantages of **Concurrency**

- **Parallel vs Concurrent**
- Decrease waiting time
- Decrease response time/ increase performance
- Resource utilization
- Increase efficiency

Problems with concurrency

- Dirty Read Problem/Uncommitted dependency/ Temporary update
- Lost Update Problem (Write-Write Conflict)
- Unrepeatable read problem
- Phantom read problem (Close to URP)
- Incorrect Summary Problem

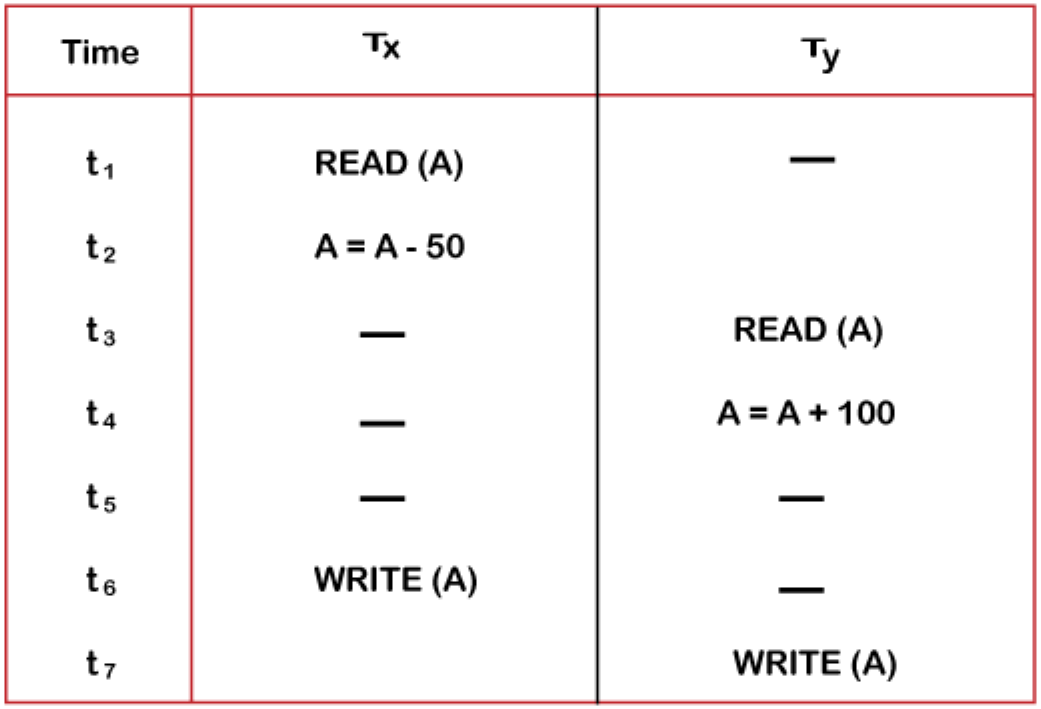
Dirty Read Problem

Transaction T1	Transaction T2
R (A)	
W (A)	
	R (A) // Dirty Read
	W (A)
	Commit
Failure	

Dirty Read Problem

- Solution
  - Ignore these type of scenario
  - Don’t read any value from local buffer
  - Read value directly from memory if needed
  - If read from local buffer before committing wait for previous transaction
  - Read value after committing
  - If read then ensure there is no possibility of failure

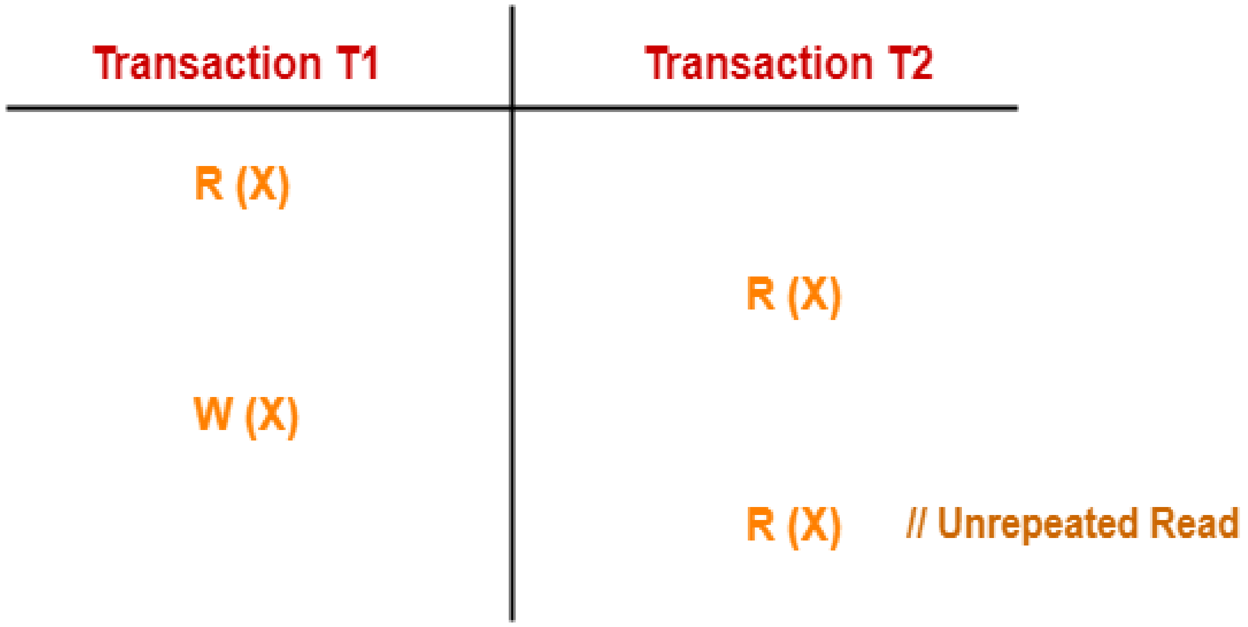
Lost Update Problem



Time	T_x	T_y
t_1	READ (A)	—
t_2	A = A - 50	
t_3	—	READ (A)
t_4	—	A = A + 100
t_5	—	—
t_6	WRITE (A)	—
t_7		WRITE (A)

LOST UPDATE PROBLEM

Unrepeatable read problem



Transaction T1	Transaction T2
R (X)	
	R (X)
W (X)	
	R (X) // Unrepeated Read

Phantom Read Problem

T1	**T2**
READ(A)	
	READ(A)
DELETE(A)	
	READ(A) // *A is missing*

Schedule

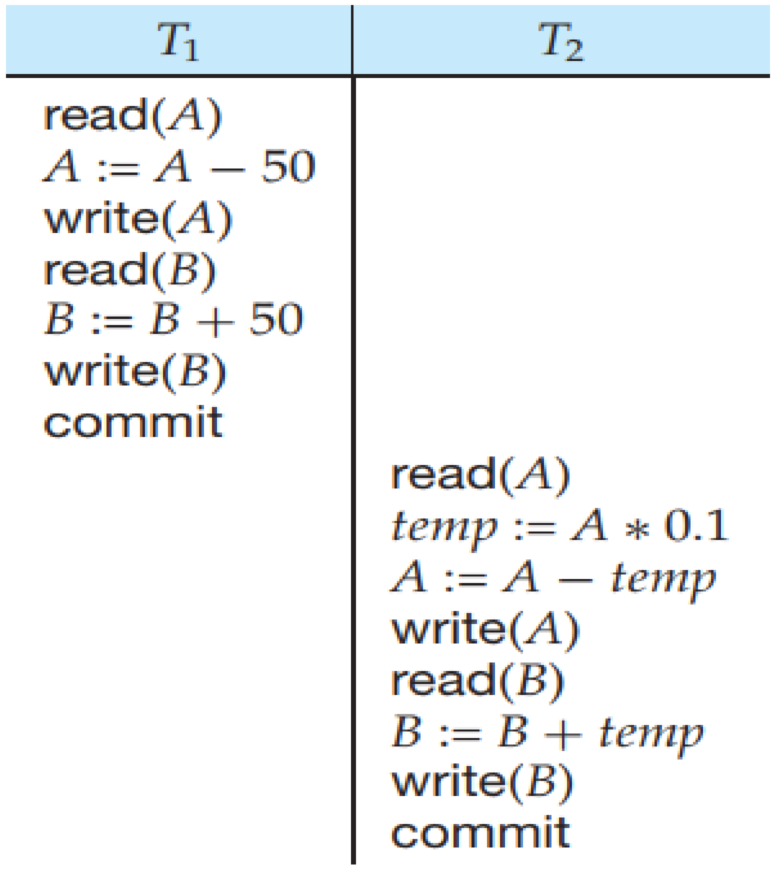
- Order of transaction is called schedule.
- Two types: ***Serial schedule*** and ***Non serial or concurrent schedule***
- SS-> less throughput, no problem with isolation
- CS-> need to manage isolation

Example of Schedule

```
$T_1$: read($A$);
       $A := A - 50$;
       write($A$);
       read($B$);
       $B := B + 50$;
       write($B$).
```

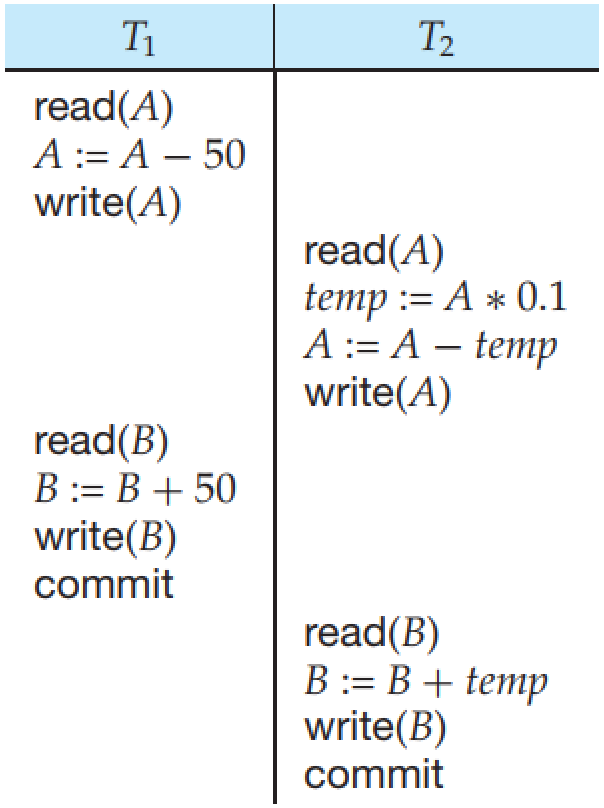
```
$T_2$: read($A$);
       $temp := A * 0.1$;
       $A := A - temp$;
       write($A$);
       read($B$);
       $B := B + temp$;
       write($B$).
```

Serial Schedule

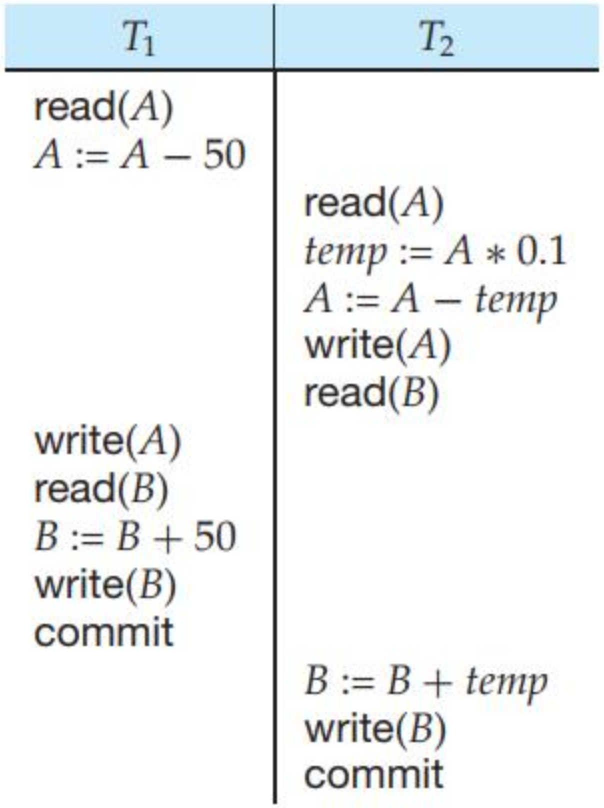


T_1	T_2
read(A)	
$A := A - 50$	
write(A)	
read(B)	
$B := B + 50$	
write(B)	
commit	
	read(A)
	$temp := A * 0.1$
	$A := A - temp$
	write(A)
	read(B)
	$B := B + temp$
	write(B)
	commit

Non Serial/Concurrent Schedule



T_1	T_2
read(A)	
$A := A - 50$	
write(A)	
	read(A)
	$temp := A * 0.1$
	$A := A - temp$
	write(A)
read(B)	
$B := B + 50$	
write(B)	
commit	
	read(B)
	$B := B + temp$
	write(B)
	commit



T_1	T_2
read(A)	
$A := A - 50$	
	read(A)
	$temp := A * 0.1$
	$A := A - temp$
	write(A)
	read(B)
write(A)	
read(B)	
$B := B + 50$	
write(B)	
commit	
	$B := B + temp$
	write(B)
	commit

Inconsistent State

Conflict Serializable

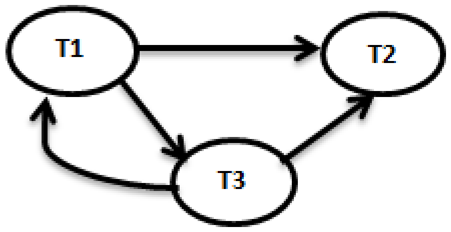
T_1	T_2
read(A)	
write(A)	
	read(A)
	write(A)
read(B)	
write(B)	
	read(B)
	write(B)

T_1	T_2
read(A)	
write(A)	
	read(A)
read(B)	
	write(A)
write(B)	
	read(B)
	write(B)

T_1	T_2
read(A)	
write(A)	
read(B)	
write(B)	
	read(A)
	write(A)
	read(B)
	write(B)

Conflict Serializable??

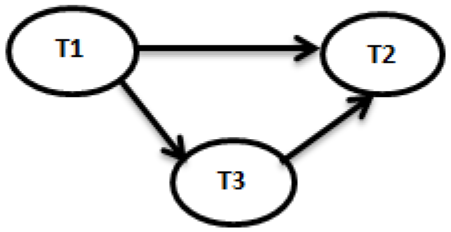
T1	T2	T3
R(X)		
		R(Z)
		W(Z)
R(Y)		
	R(Y)	
	W(Y)	
		W(X)
	W(Z)	
W(X)		



Non Conflict Serializable Schedule

Conflict Serializable??

T1	T2	T3
R(X)		
	R(Y)	
		R(Y)
	W(Y)	
W(X)		
		W(X)
	R(X)	
	W(X)	


$$\begin{tikzcd} T1 \arrow[rr] \arrow[dr] & & T2 \\ & T3 \arrow[ur] & \end{tikzcd}$$

T1→T3→T2

Conflict Serializable Schedule

Conflict Serializable??

S: R1 (B), R3(C), R1 (A), W2(A), W1(A), W2(B), W3 (A), W1 (B), W3 (B), W3(C)

T1	T2	T3
R(B)		
		R(C)
R(A)		
	W(A)	
W(A)		
	W(B)	
		W(A)
W(B)		
		W(B)
		W(C)

References

- 7th edition (Chapter 17)