COMPUTER SCIENCE

Database Management System

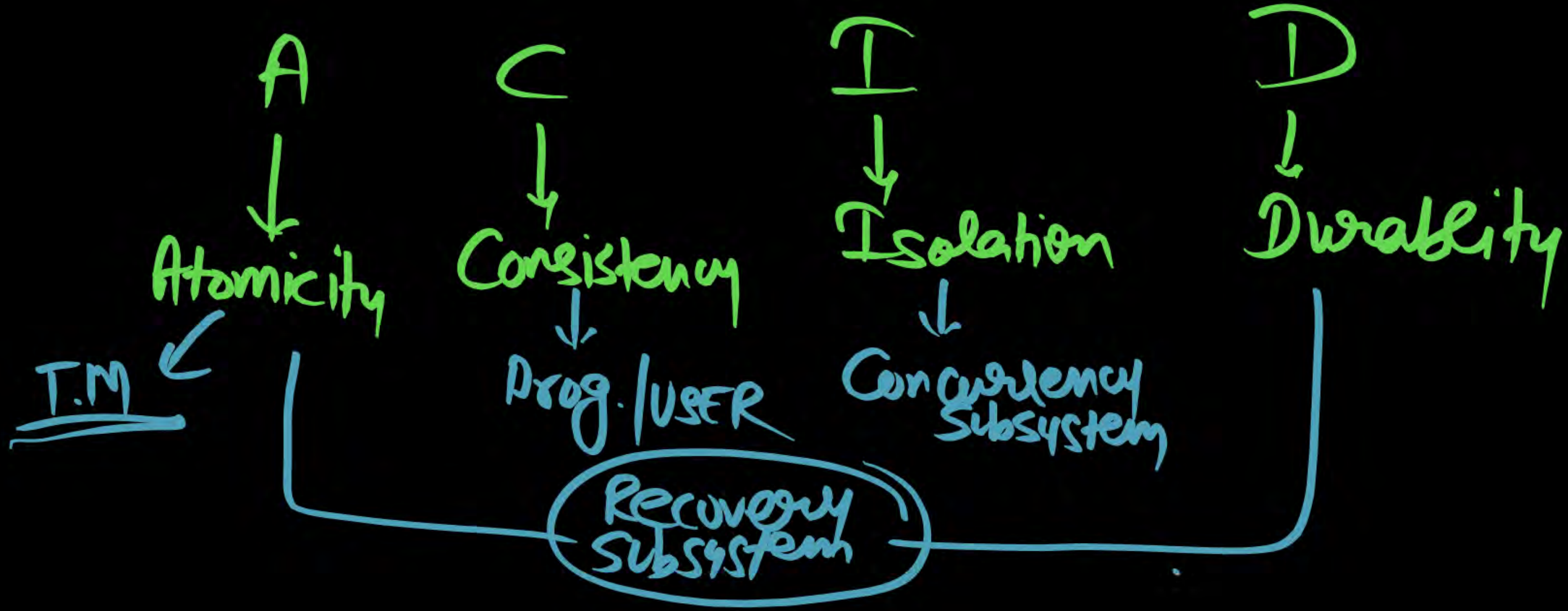
Transaction & Concurrency Control

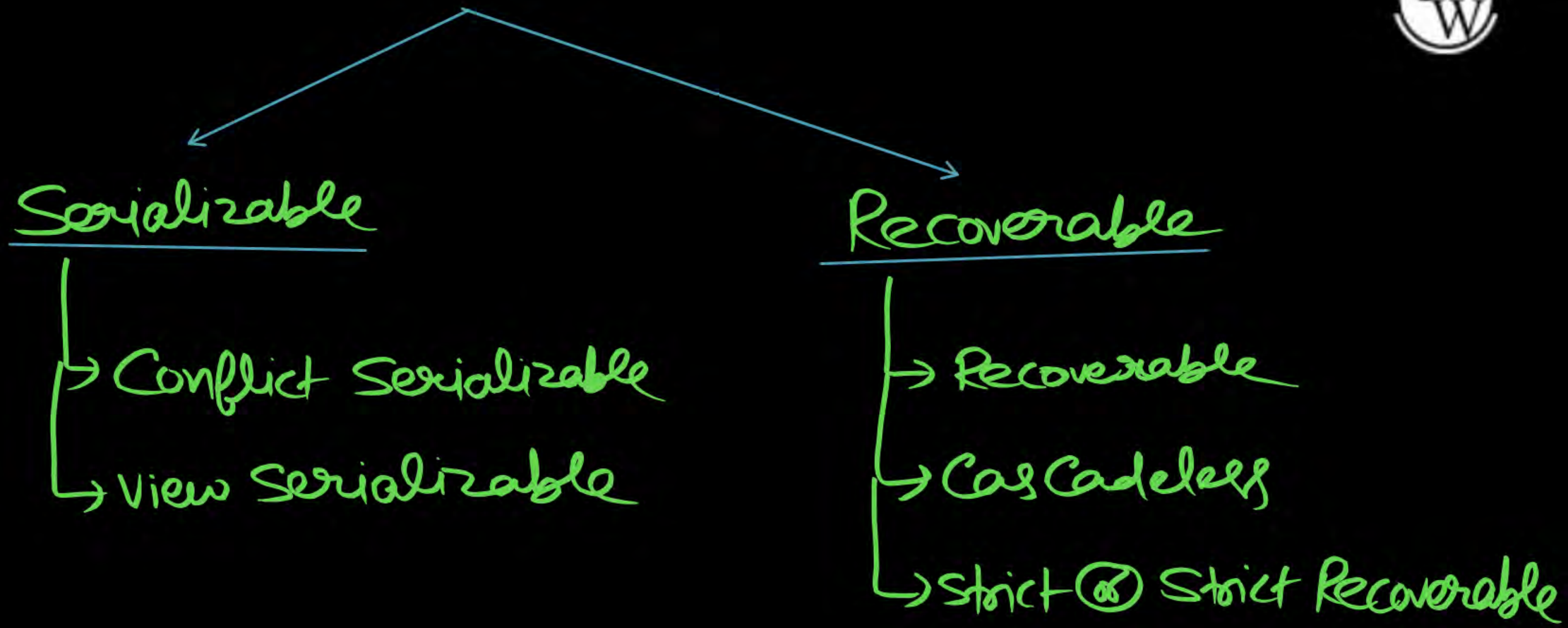
Lecture_6

Vijay Agarwal sir

01 Finding Conflict Serializable Schedule

Transaction




Serializable
Conflict Serializable
View Serializable
Recoverable
Recoverable
Cascadeless
Strict & Strict Recoverable

Finding Number of Conflict Serializable.

① Write Down all operation of the following (later) Transaction.

② Starts from last operation of the first transaction & try to Put at Correct place Such that Conflict operation order Must be Maintained Same as Transaction order.

Q.1

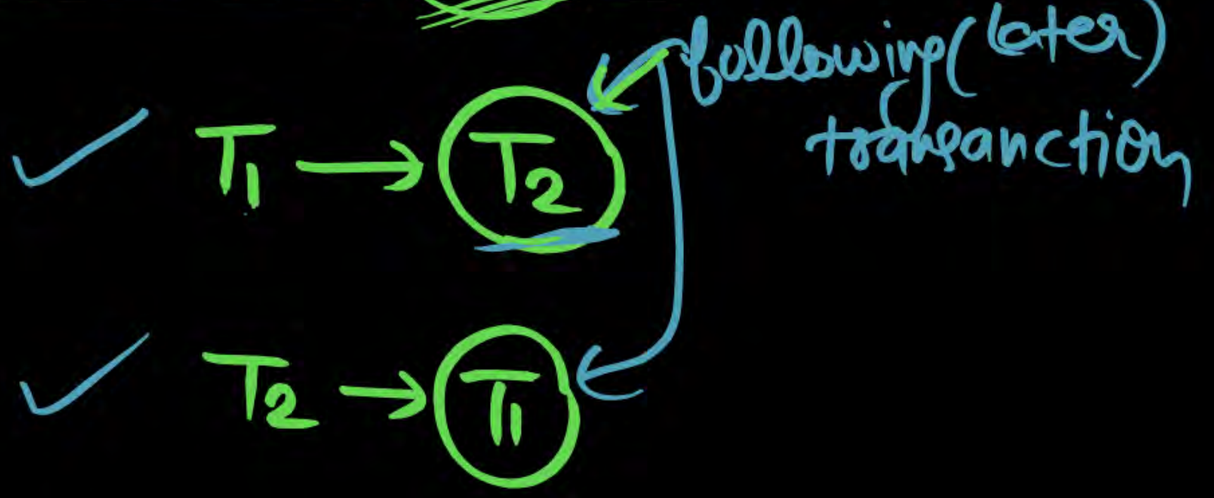
Two transactions T_1 and T_2 are given as

T_1: $r_1(X)$ $w_1(X)$ $r_1(Y)$ $w_1(Y)$

T_2: $r_2(Y)$ $w_2(Y)$ $r_2(Z)$ $w_2(Z)$

Where $r_i(V)$ denotes a read operation by transaction T_i on a variable V and $w_i(V)$ denotes a write operation by transaction T_i on a variable V. The total number of conflict serializable schedules that can be formed by T_1 and T_2 is ____ 54 Ans

[NAT:2017–2M]



Conflict

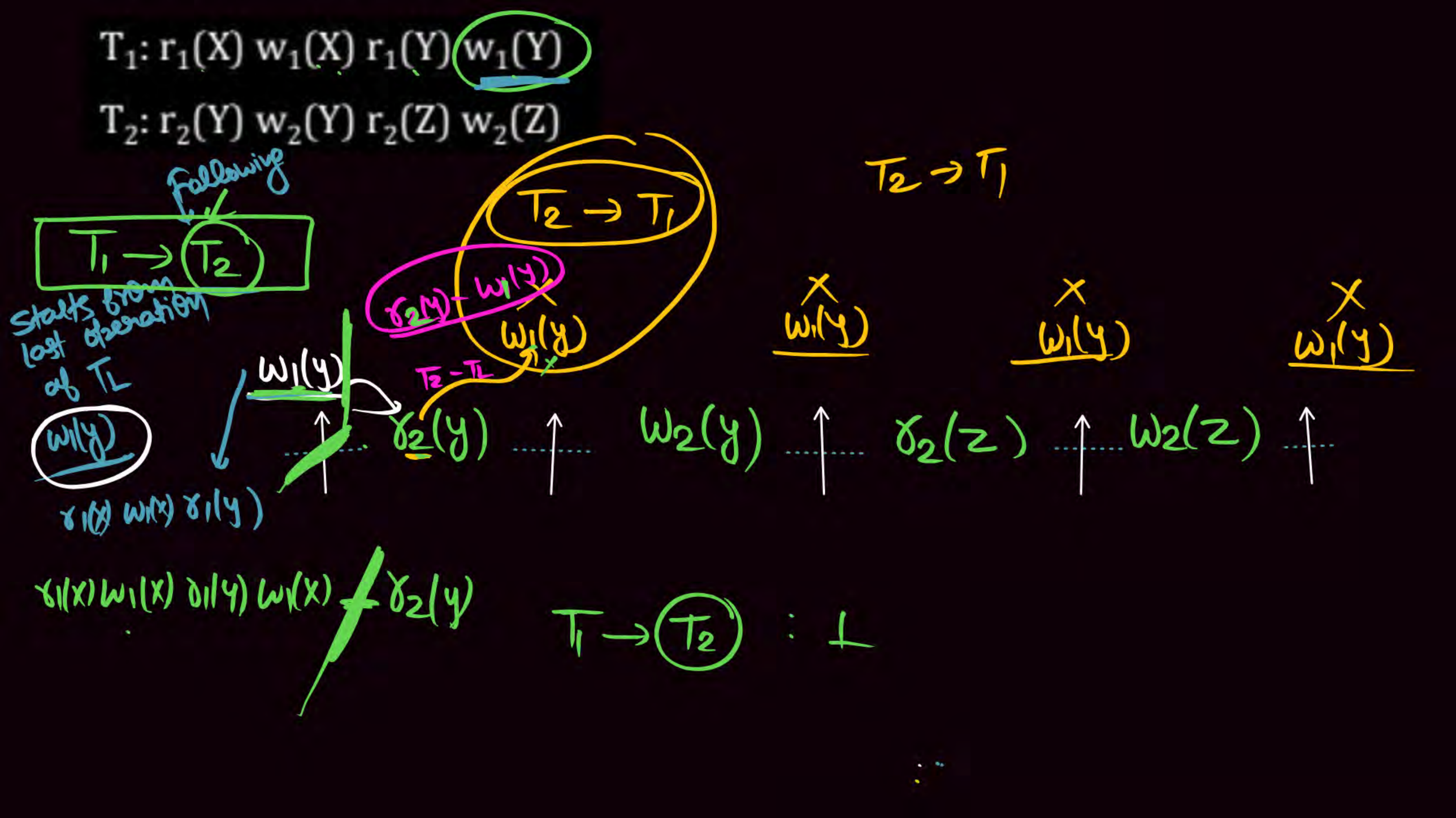
R(Q) – W(Q)

W(Q) – R(Q)

W(Q) – W(Q)

T_1: $r_1(X)$ $w_1(X)$ $r_1(Y)$ $w_1(Y)$

T_2: $r_2(Y)$ $w_2(Y)$ $r_2(Z)$ $w_2(Z)$



T_1: $r_1(X)$ $w_1(X)$ $r_1(Y)$ $w_1(Y)$

T_2: $r_2(Y)$ $w_2(Y)$ $r_2(Z)$ $w_2(Z)$

$T_2 \rightarrow T_1$ (following)

Start from last operation of first transaction (T_2)

$w_2(y)$

$r_2(z)$ $w_2(z)$

Now $w_2(y)$

$r_2(Z)$ $w_2(Z)$ Can be Placed Anywhere Because Different Data Item(Z).
But Only after $w_2(y)$.

$r_1(y)$ - $w_2(y)$: $T_1 \rightarrow T_2$

$r_1(X)$ $w_2(y)$ $w_1(X)$ $w_2(y)$ $r_1(y)$ $w_2(y)$ $w_1(y)$

CASE III

CASE II

CASE I

CASE I: $r_1(X)$ $w_1(X)$ $w_2(y)$ $r_1(y)$ $w_1(y)$

CASE II: $r_1(X)$ $w_2(y)$ $w_1(X)$ $r_1(y)$ $w_1(y)$

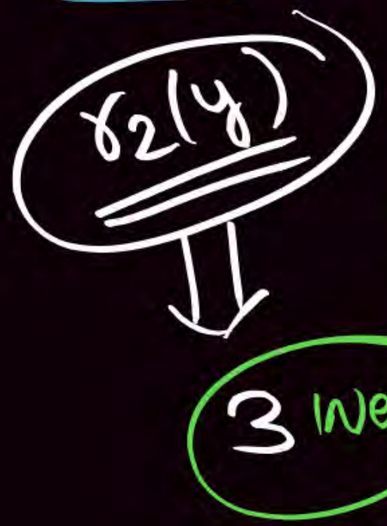
CASE III: $w_2(y)$ $r_1(X)$ $w_1(X)$ $r_1(y)$ $w_1(y)$

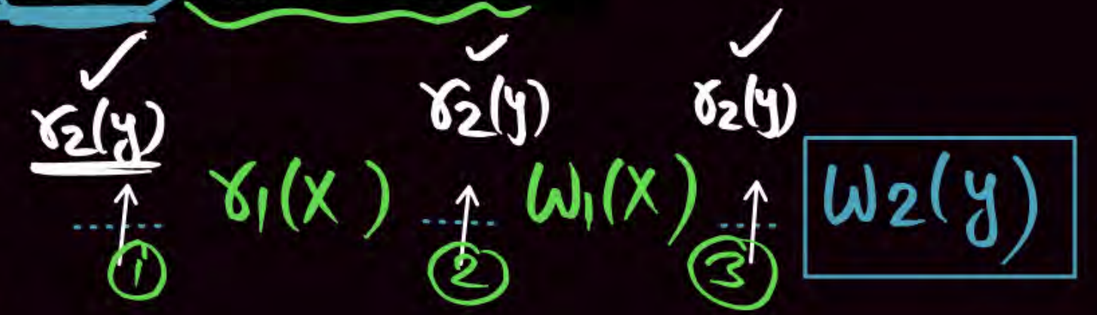
T_1: $r_1(X)$ $w_1(X)$ $r_1(Y)$ $w_1(Y)$

T_2: $r_2(Y)$ $w_2(Y)$ $r_2(Z)$ $w_2(Z)$

$T_2 \rightarrow T_1$

CASE I





$r_2(y)$

$3 \times [3C_1 + 3C_2]$

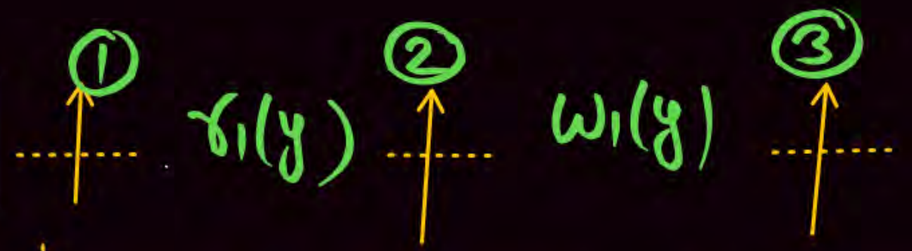
$r_2(z)\ w_2(z)$

$3 \times [3+3]$

3×6

Case I = 18 Way

$r_2(z)\ w_2(z)$



Out of 3 Place Put them $r_2(z)\ w_2(z)$ together $[3C_1]$

OR

Out of 3 Place Put them Separately $[3C_2]$

$3C_1 + 3C_2$

T_1: $r_1(X)$ $w_1(X)$ $r_1(Y)$ $w_1(Y)$

T_2: $r_2(Y)$ $w_2(Y)$ $r_2(Z)$ $w_2(Z)$

$T_2 \rightarrow T_1$

CASE II :

$r_2(y)$ → 2 way ⇒ $2 \times [{}^4C_1 + {}^4C_2]$

$2 \times [4 + 6]$

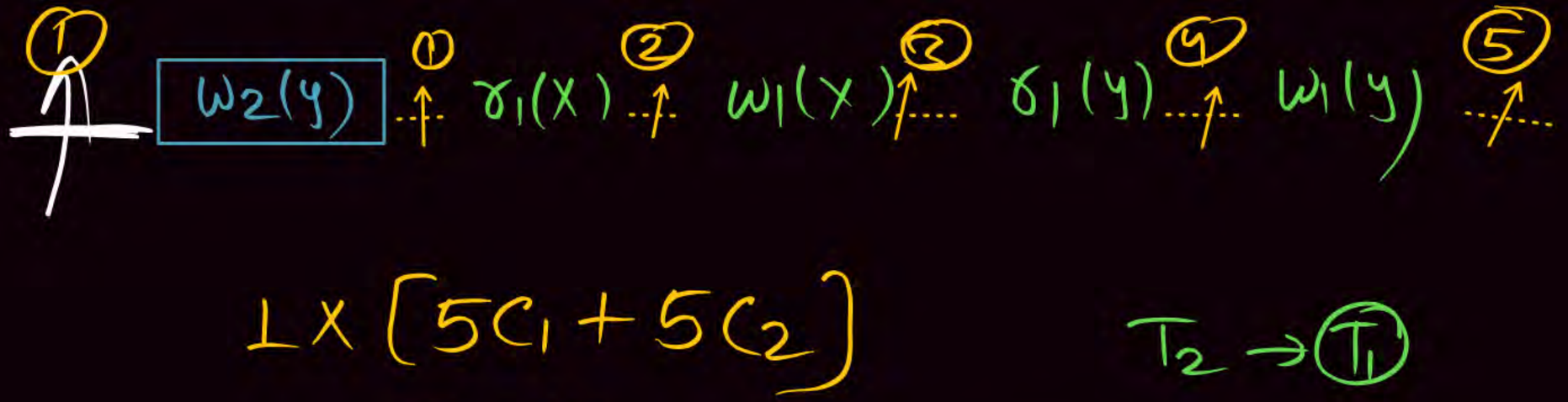
2×10

CASE II : 20 way

T_1: $r_1(X)$ $w_1(X)$ $r_1(Y)$ $w_1(Y)$

T_2: $r_2(Y)$ $w_2(Y)$ $r_2(Z)$ $w_2(Z)$

CASE III



$1 \times [5C_1 + 5C_2]$

$5 + 10$

Case III : 15 Way.

$T_2 \rightarrow T_1$

CASE I : 18

CASE II : 20

CASE III : 15

53.

T_1: $r_1(X)$ $w_1(X)$ $r_1(Y)$ $w_1(Y)$

T_2: $r_2(Y)$ $w_2(Y)$ $r_2(Z)$ $w_2(Z)$

$T_1 \rightarrow (T_2)$: 1

$T_2 \rightarrow (T_1)$: 53

54 Ans

Q.2

Consider the transaction T_1 and T_2 given below: **[NAT]**

T_1 : $R_1(A)$ $R_1(B)$ $W_1(B)$

T_2 : $R_2(A)$ $R_2(B)$ $W_2(B)$

T_1 & T_2 Exact Mirror Copy Operation & order all are same

Where $R_i(A)$ denote a read operation by transaction T_i on a Data Item (A) W_i (B) Denote a write operation by transaction T_i on a Data Item B.

The Total number of conflict serializable schedule is 8 . Ans

$T_1 \rightarrow T_2$: 4

$T_2 \rightarrow T_1$: 4

8

T_1 : $R_1(A)$ $R_1(B)$ $W_1(B)$

T_2 : $R_2(A)$ $R_2(B)$ $W_2(B)$

- $R_2(B) - W_1(B)$: $T_2 \rightarrow T_1$ But Schedule is $T_1 \rightarrow T_2$
- $W_2(B) - W_1(B)$

$T_1 \rightarrow T_2$

$W_1(B)$

$W_2(B)$ ✓ $R_2(A)$ $W_1(B)$ ✓ $R_2(B)$ $W_1(B)$ ✗ $W_2(B)$ $W_1(B)$ ✗

CASE II CASE I

CASE I

$R_2(A)$ $W_1(B)$ $R_2(B)$ $W_2(B)$

CASE II

$W_1(B)$ $R_2(A)$ $R_2(B)$ $W_2(B)$

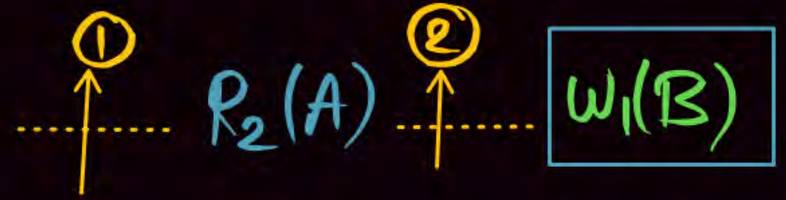
∴

T_1: $R_1(A)$ $R_1(B)$ $W_1(B)$

T_2: $R_2(A)$ $R_2(B)$ $W_2(B)$

CASE I:

$R_1(A)$ $R_1(B)$



$R_2(B)$ $W_2(B)$

$$2C_1 + 2C_2 = 2 + 1 = 3$$

out of 2 place sit them together $2C_1$

(or)

out of 2 place, sit them separately $2C_2$

CASE II

$R_1(A)R_1(B)$ → $W_1(B)$ $R_2(A)$ $R_2(B)$ $W_2(B)$

1

Case I : 3
Case II : 1

$T_1 \rightarrow (T_2)$: 4

$T_2 \rightarrow (T_1)$: 4

Total Conflict serializable : (8)

Serial schedule ↓

Non serial Conflict serializable = 8 − 2

= 6 Ans

Q.3

Consider the transaction T_1 and T_2 given below: [NAT]

T_1 : $R_1(A)$ $R_1(B)$ $W_1(B)$

T_2 : $R_2(B)$ $R_2(A)$ $W_2(B)$

Where $R_i(A)$ denote a read operation by transaction T_i on a Data Item (A) W_i (B) Denote a write operation by transaction T_i on a Data Item B.

The Total number of conflict serializable schedule is_____.

Q.4

Consider given schedule:

S: $r_1(x), r_2(y), w_3(y), r_4(x), w_4(z), w_3(y)$

How many conflict serializable schedules exists for the above schedule S?

T_1	T_2	T_3	T_4
r(x)			
	r(y)		
		w(y)	
			r(x)
			w(z)
		w(y)	

Any(12)

Any(12) T_1

T_1 & T_4 can be placed Any where

T_4

T_2

T_3

$T_2 \rightarrow T_3$

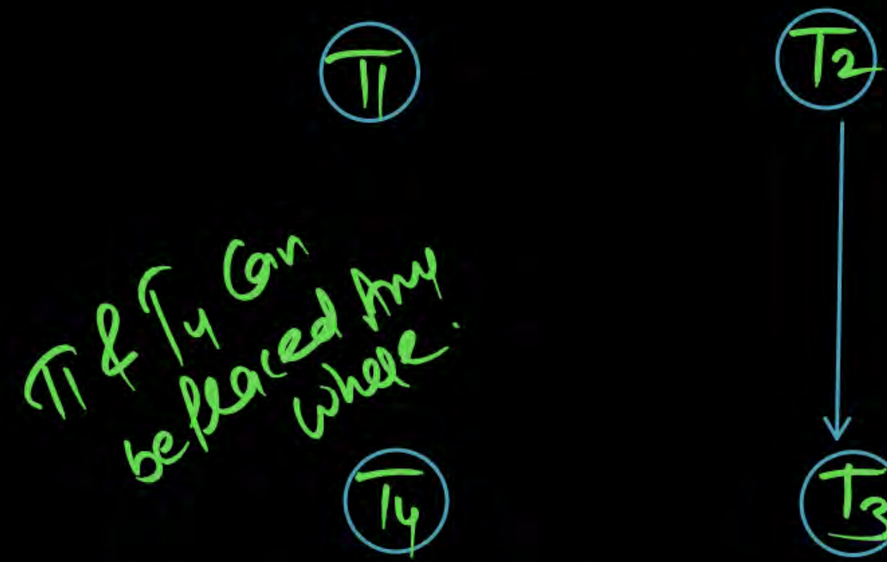
Q.4 Consider given schedule:

S: $r_1(x), r_2(y), w_3(y), r_4(x), w_4(z), w_3(y)$

How many conflict serializable schedules exists for the above schedule S?

T_1	T_2	T_3	T_4
r(x)			
	r(y)		
		w(y)	
			r(x)
			w(z)
		w(y)	

Any (12)



(1) T_2 (2) T_3 (3)

3! 2!

= 12

T_1 & T_4 can be place Any Where.

First T_1 T_1 T_2 T_1 T_3 T_1

CASE I T_4 T_1 T_4 T_2 T_4 T_3 T_4 4

CASE II ... T_2 ..... T_1 ..... T_3 4

CASE III ... T_2 .... T_3 ... T_1 4

12 Case

Now for T_4

CASE I

T_4 T_1 T_2 T_3

T_1 T_4 T_2 T_3

T_1 T_2 T_4 T_3

T_1 T_2 T_3 T_4 } 4

T_4 T_2 T_1 T_3

T_2 T_4 T_1 T_3

T_2 T_1 T_4 T_3

T_2 T_1 T_3 T_4 } 4

T_4 T_2 T_3 T_1 3 4

T_2 T_4 T_3 T_1

T_2 T_3 T_4 T_1 & $T_2 T_3 T_1 T_4$

Q. (1) How Many (Number of) Conflict Serializable

Q. (2) Number of Conflict Equivalent

Q.5

Consider the following schedule

$S = r_1(P); r_3(S); w_1(Q); r_2(Q)\ r_4(Q), w_2(R); r_5(R); w_4(T); r_5(T); w_5(Q)$

How many serial schedules are possible which will be view equal to S? 10 Ans

① Initial Read : P : T_1 S : T_3

② Final Write : Q : $T_5 \Rightarrow T_1 \rightarrow T_5$

③ Updated Read (Write-Read Sequence)

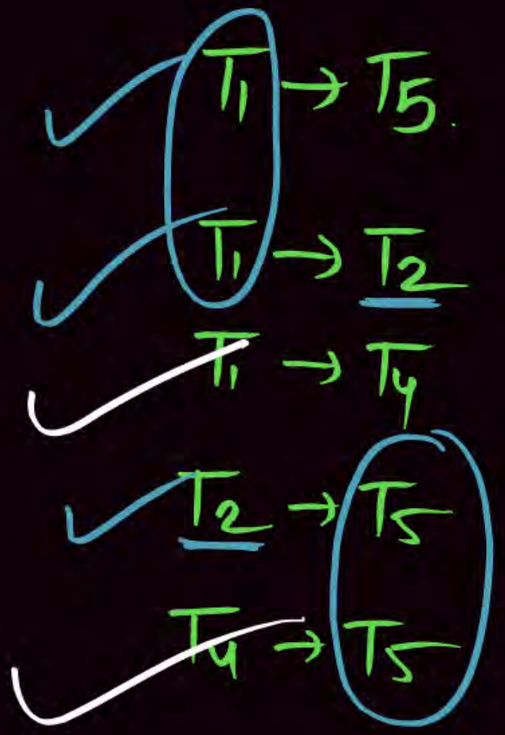
$w_1(Q) - r_2(Q)$: $T_1 \rightarrow T_2$

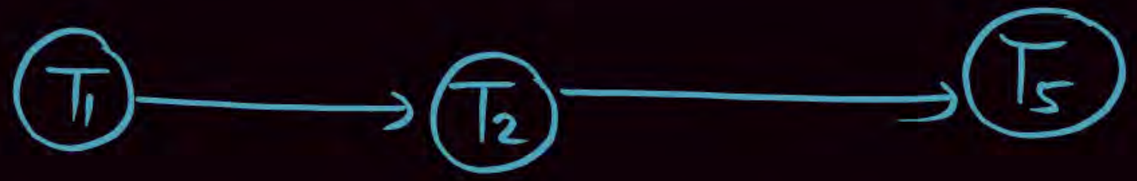
$w_1(Q) - r_4(Q)$: $T_1 \rightarrow T_4$

$w_2(R) - r_5(R)$: $T_2 \rightarrow T_5$

$w_4(T) - r_5(T)$: $T_4 \rightarrow T_5$

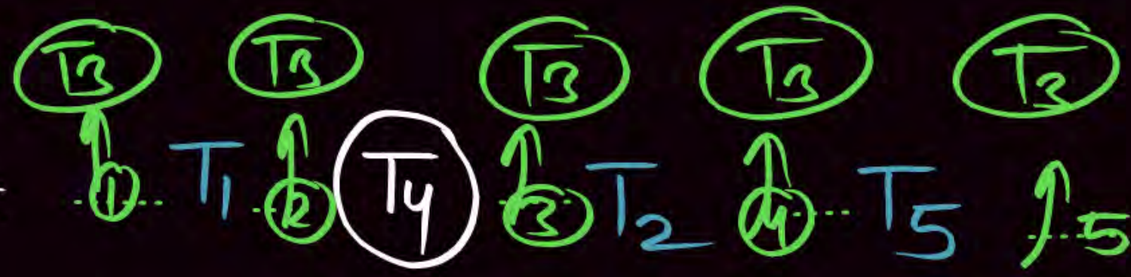
T_1	T_2	T_3	T_4	T_5
r(P)				
		r(S)		
w(Q)				
	r(Q)			
			r(Q)	
	w(R)			
			w(T)	r(R)
				r(T)
				w(Q)





T_4 Comes After T_1 & Before T_5

CASE I

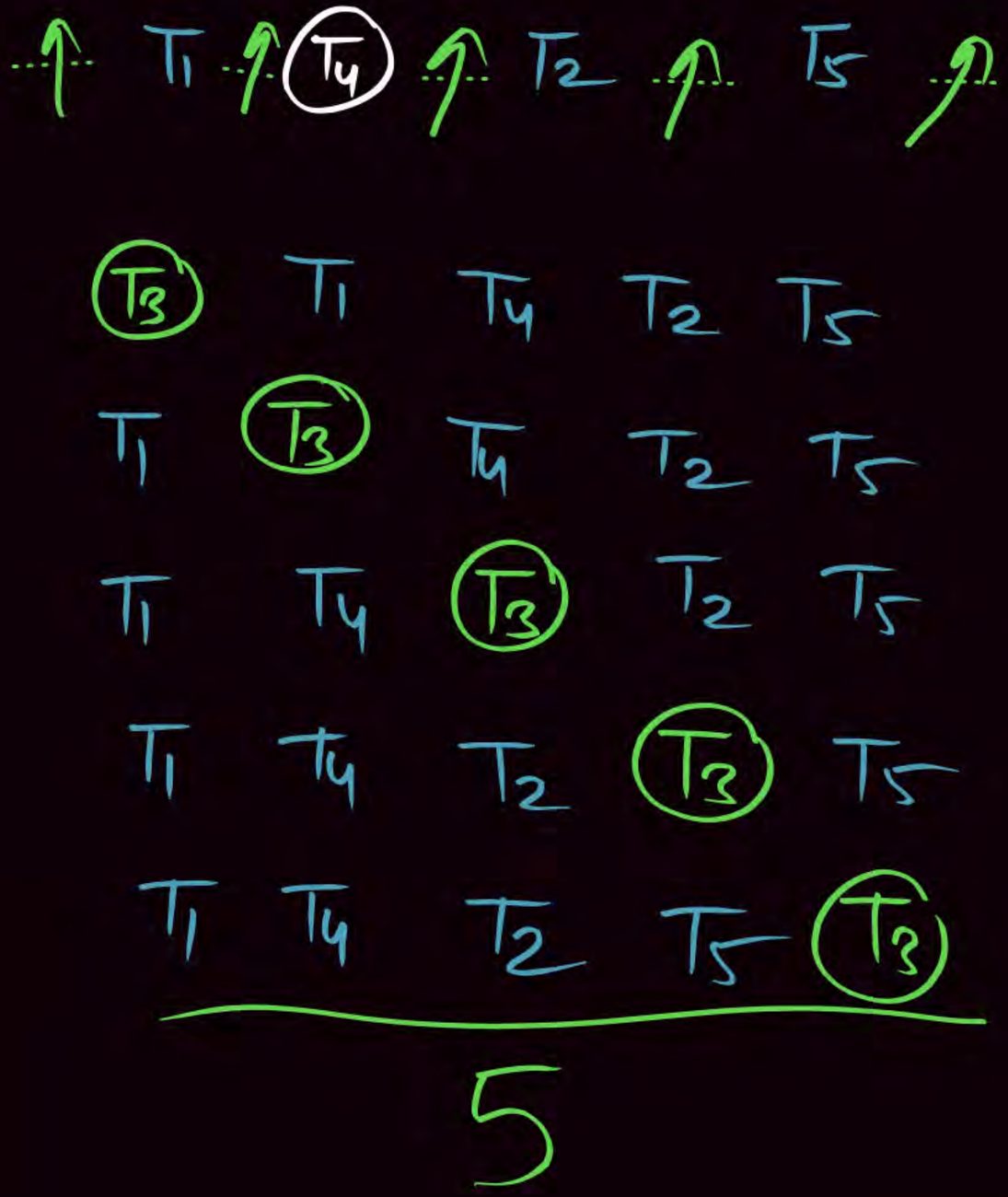


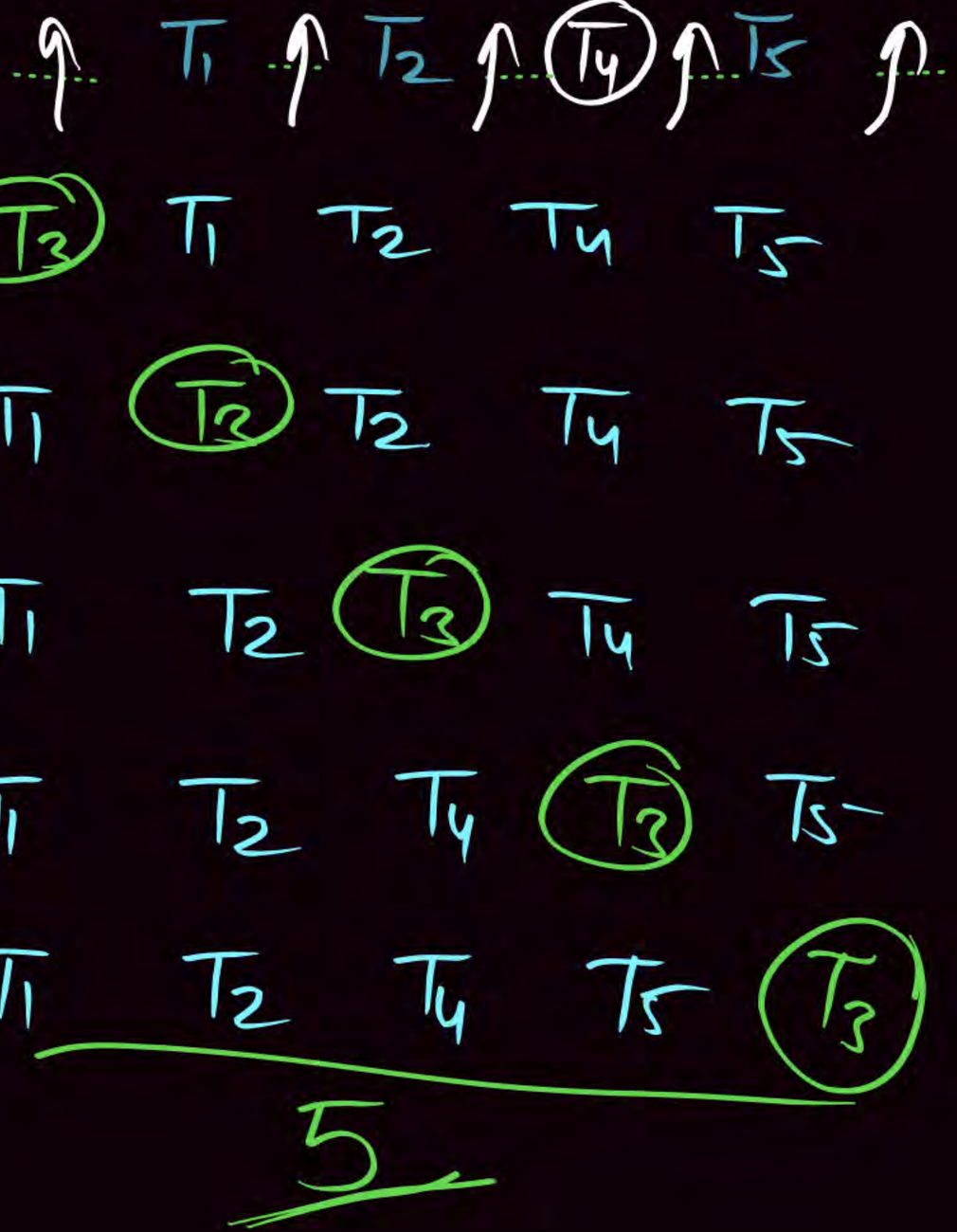
$f_5 = 5$

CASE II .... T_1 .... T_2 .... T_4 .... T_5 .... $= 5$

for T_3

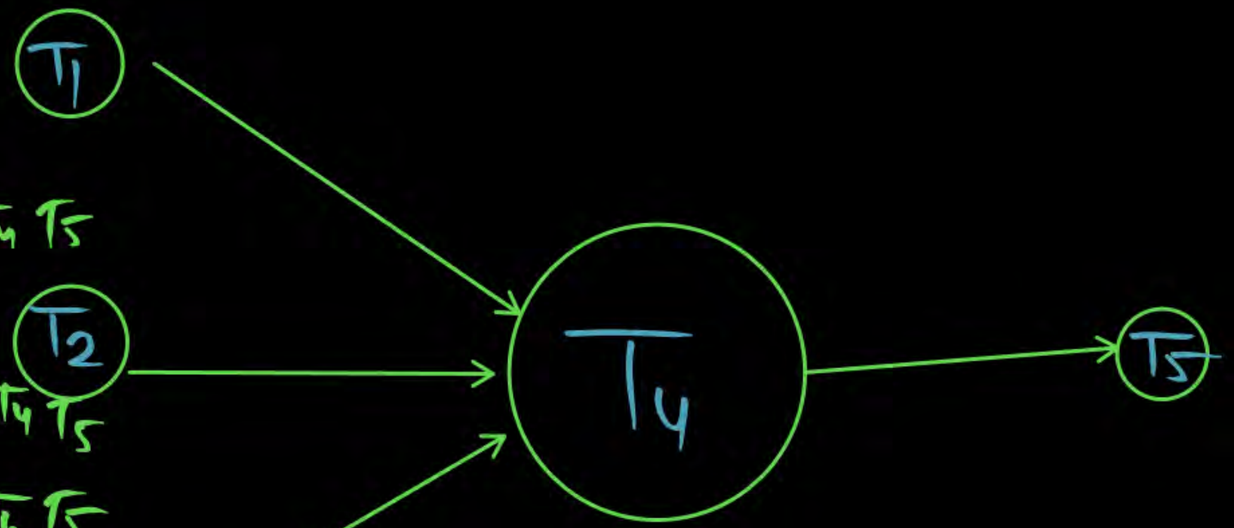
10 Ans


T1 T4 T2 T5
T3 T1 T4 T2 T5
T1 T3 T4 T2 T5
T1 T4 T3 T2 T5
T1 T4 T2 T3 T5
T1 T4 T2 T5 T3
5


T1 T2 T4 T5
T3 T1 T2 T4 T5
T1 T3 T2 T4 T5
T1 T2 T3 T4 T5
T1 T2 T4 T3 T5
T1 T2 T4 T5 T3
5

Topological Sorting

$3! = 6$



T1 T2 T3 T4 T5

T1 T3 T2 T4 T5

T2 T1 T3 T4 T5

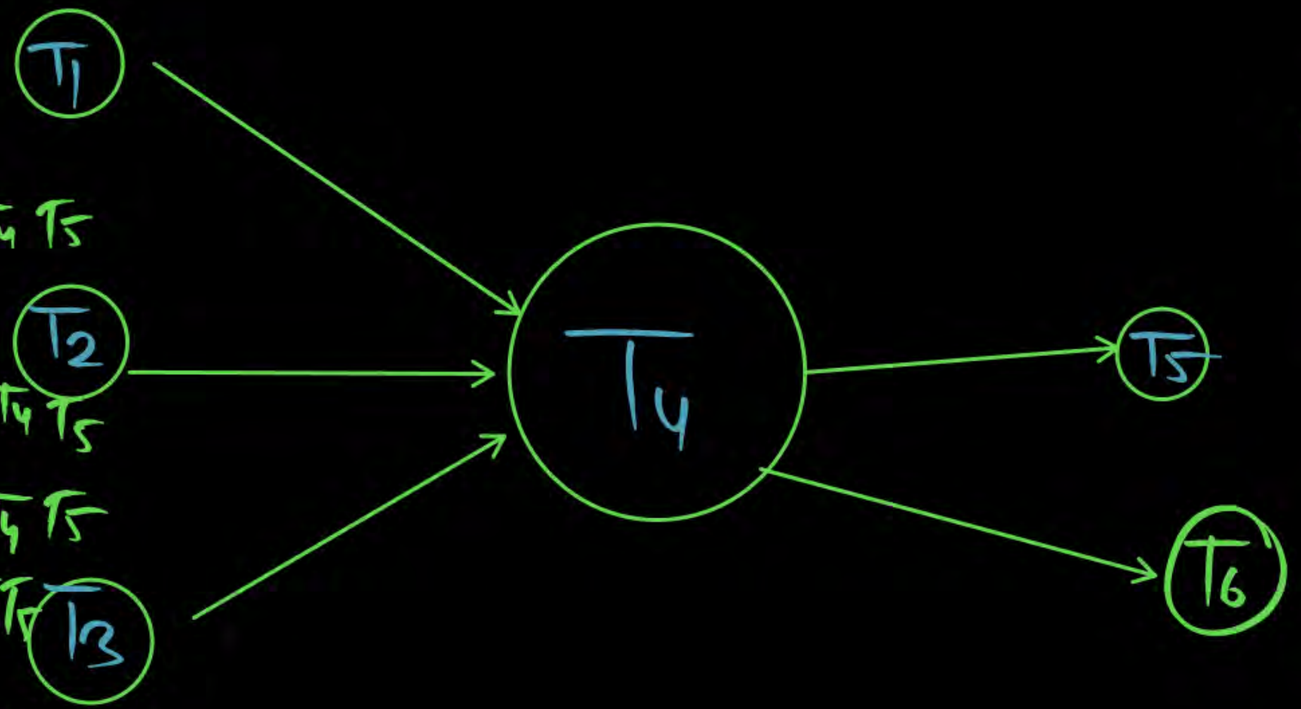
T2 T3 T1 T4 T5

T3 T1 T2 T4 T5

T3 T2 T1 T4 T5

Topological Sorting

$3! = 6$



T1 T2 T3 T4 T5

T1 T3 T2 T4 T5

T2 T1 T3 T4 T5

T2 T3 T1 T4 T5

T3 T1 T2 T4 T5

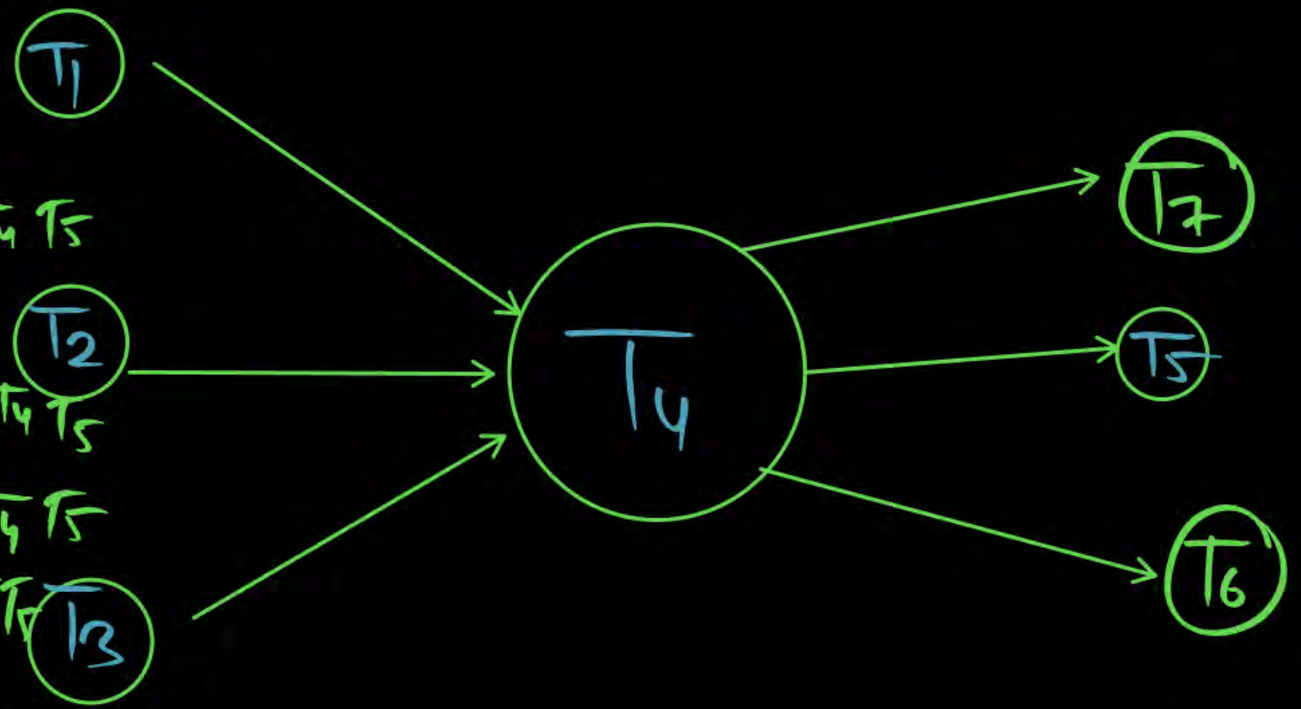
T3 T2 T1 T4 T5

$3! \times 1 \times 2!$

$6 \times 1 \times 2 = 12$

Topological Sorting

$3! = 6$



T1 T2 T3 T4 T5

T1 T3 T2 T4 T5

T2 T1 T3 T4 T5

T2 T3 T1 T4 T5

T3 T1 T2 T4 T5

T3 T2 T1 T4 T5

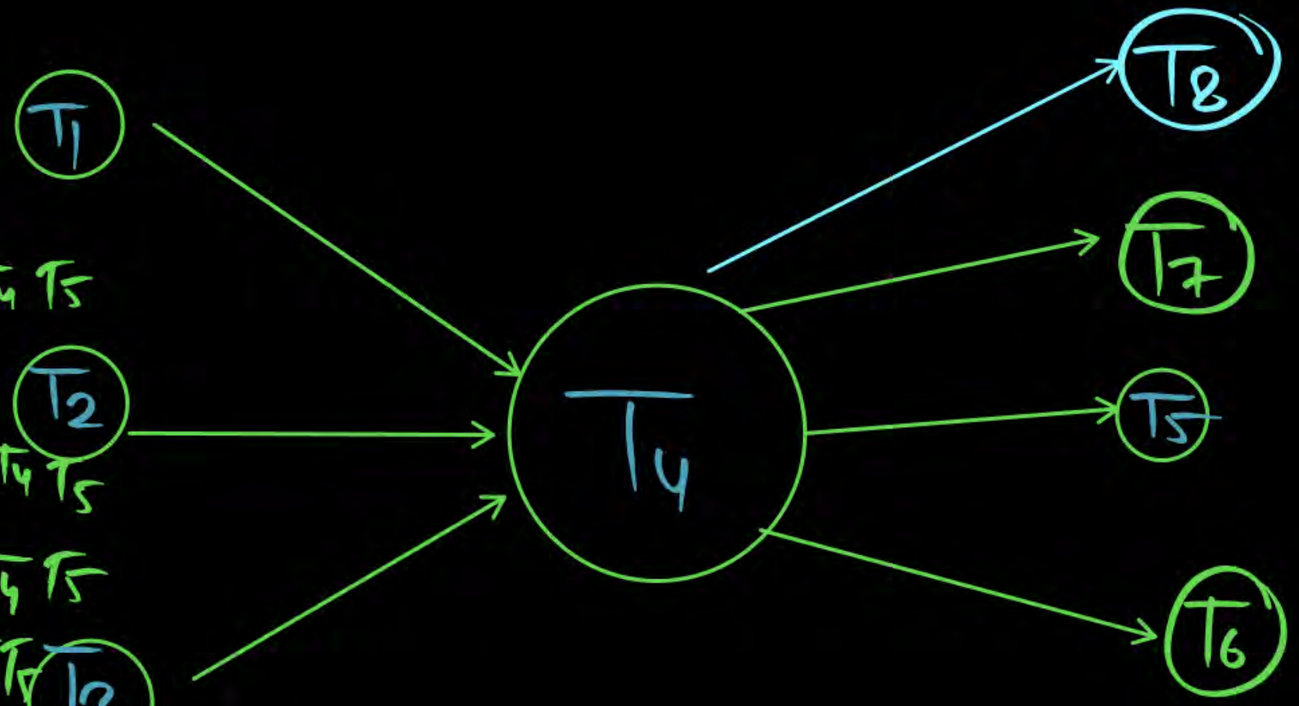
$3! \times (T_4) \times 3!$

$6 \times 1 \times 6$

$= 36$ Ans

Topological Sorting

$3! = 6$



T1 T2 T3 T4 T5

T1 T3 T2 T4 T5

T2 T1 T3 T4 T5

T2 T3 T1 T4 T5

T3 T1 T2 T4 T5

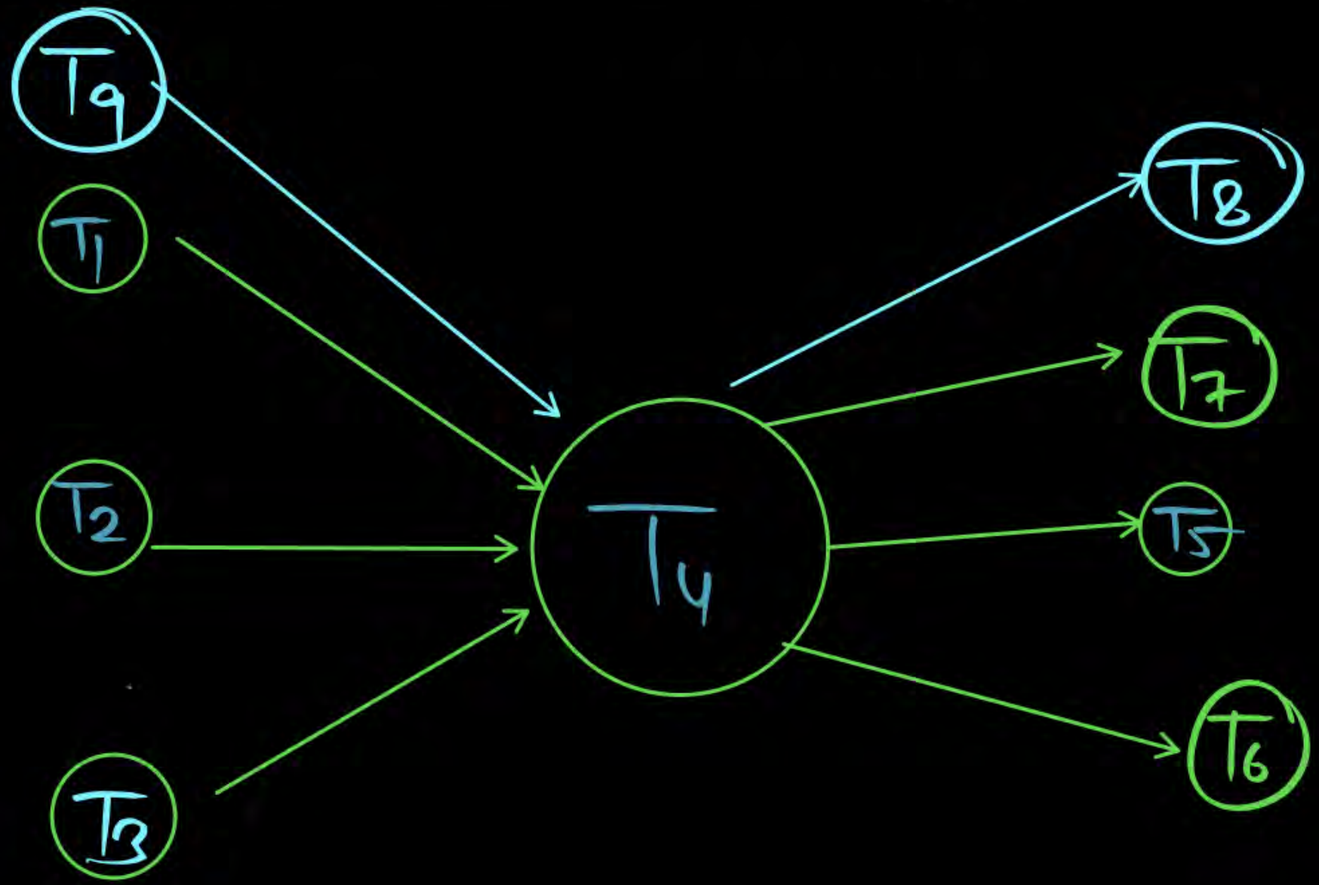
T3 T2 T1 T4 T5

$3! \times 1 \times 4!$

$6 \times 1 \times 24$

$\Rightarrow$ 144 Ans

Topological Sorting



$3! = 6$

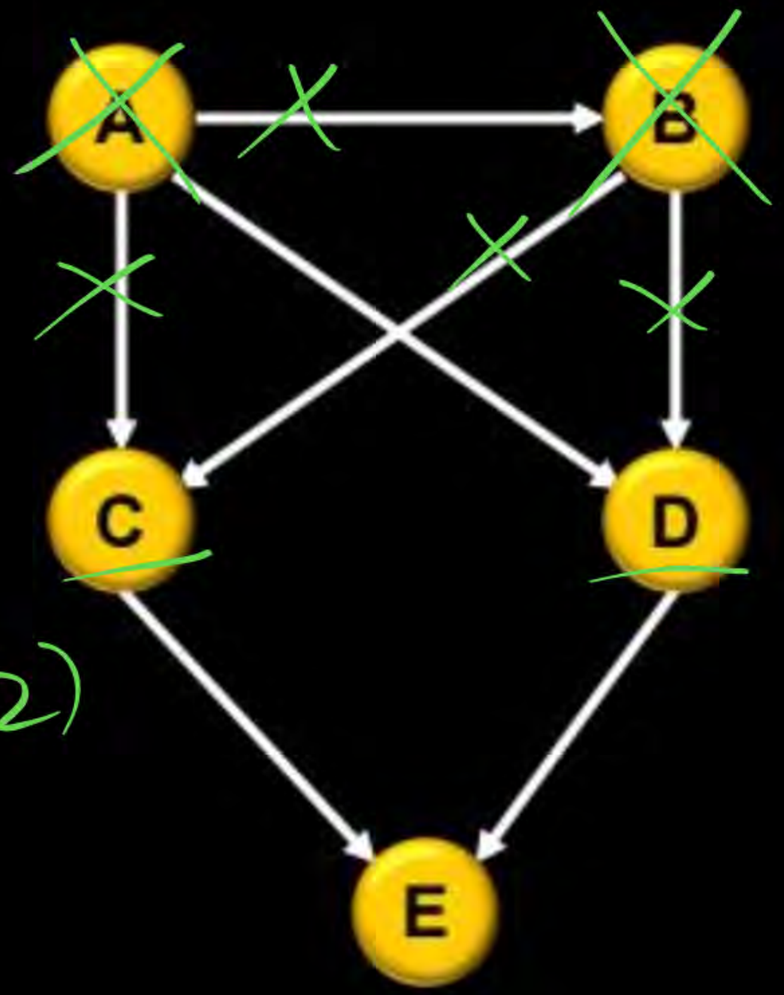
$4! \times 1 \times 4!$

24×24

$\Rightarrow 576$ Ans

Topological Sorting

Q.



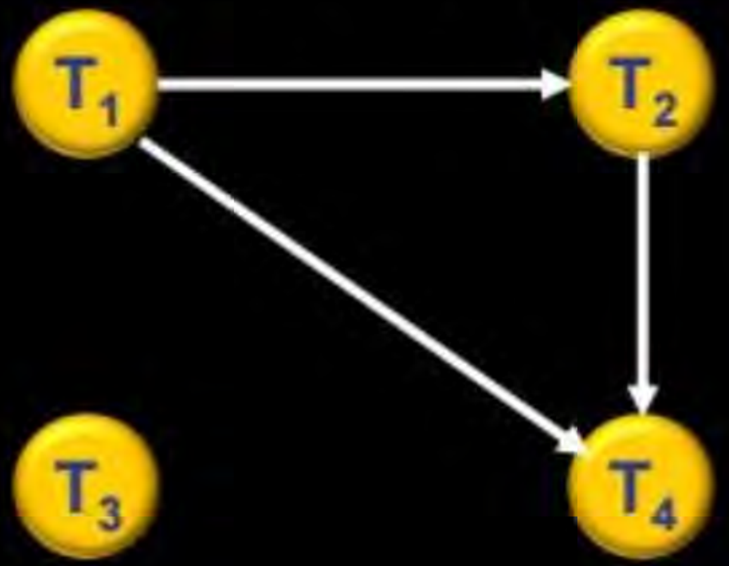
Ans (2)

A B C D E

A B D C E

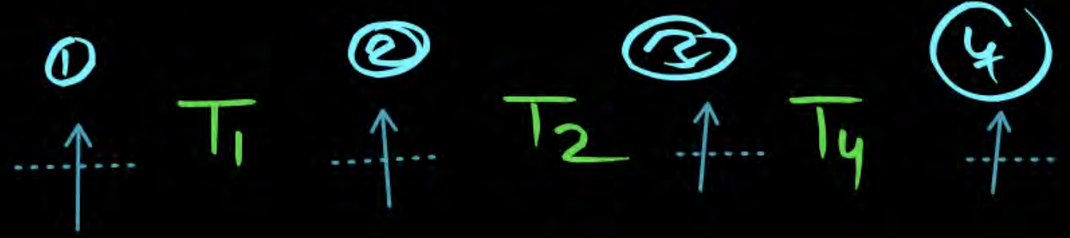
Topological Sorting

Q.



Ans (4)

T3



< T3 T1 T2 T4 >

< T1, T3 T2 T4 >

< T1, T2, T3 T4 >

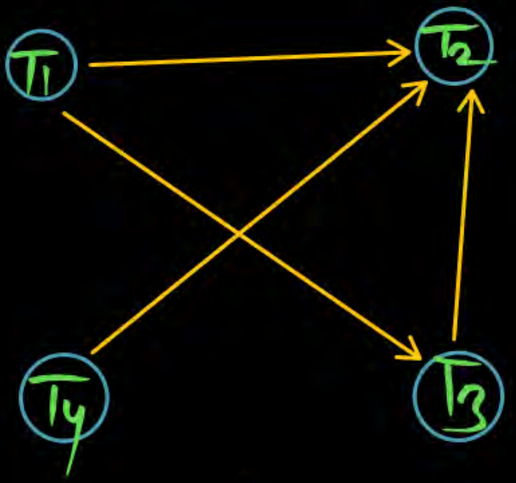
< T1 T2 T4 T3 >

4 Ans

Topological Sorting

Q.

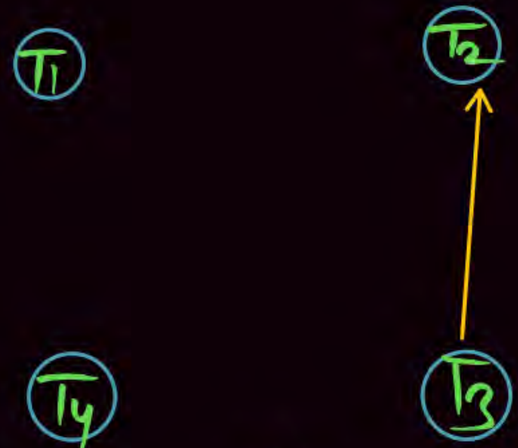
$R_4(x)$ $R_2(x)$ $R_3(x)$ $W_1(y)$ $W_2(x)$ $R_3(y)$ $W_2(y)$



Ans(3)

. $T_1\ T_3, T_4, T_2$

T4



$\langle T_1\ T_4, T_3, T_2 \rangle$

$\langle T_4\ T_1\ T_3\ T_2 \rangle$

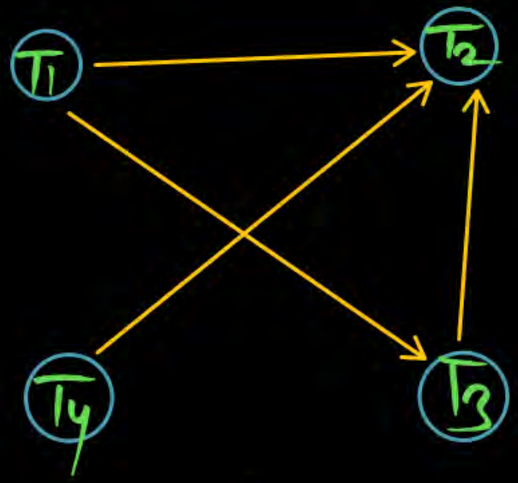
$\langle T_1, T_3, T_4, T_2 \rangle$

Ans

Topological Sorting

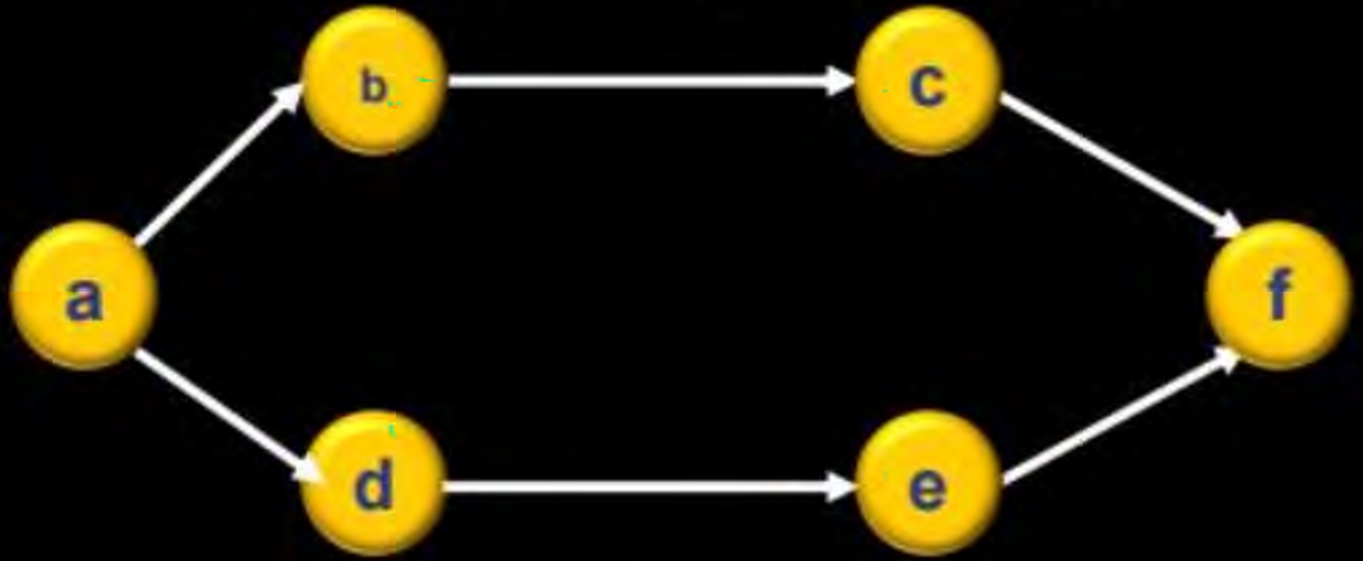
Q.

$R_4(x)$ $R_2(x)$ $R_3(x)$ $W_1(y)$ $W_2(x)$ $R_3(y)$ $W_2(y)$



Topological Sorting

Q. Consider the following directed graph:

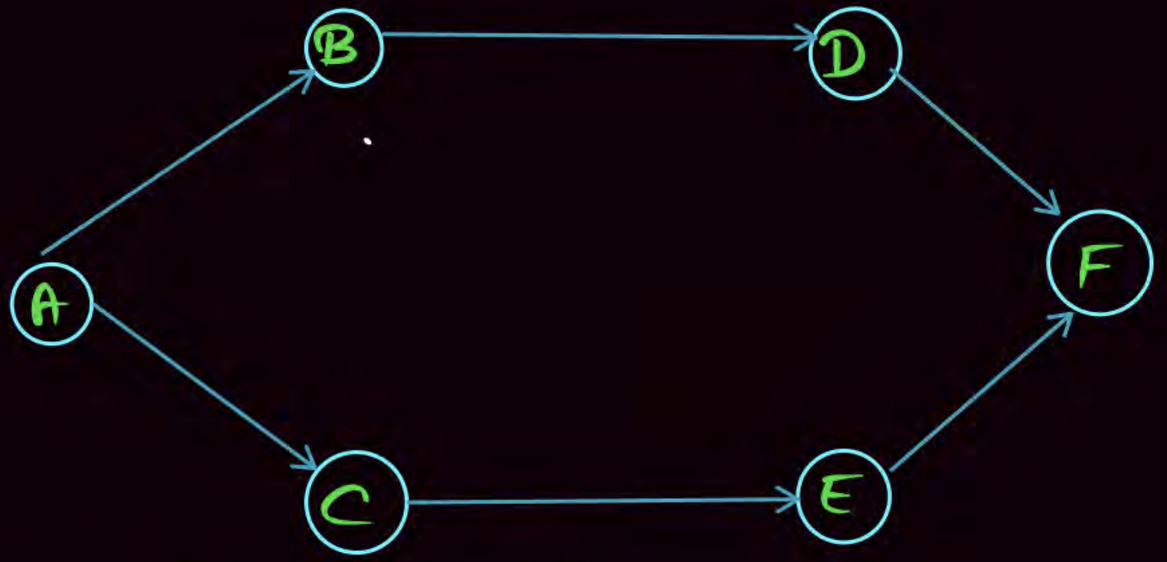


a b

Topological sorting : 6

The number of different topological ordering of the vertices of the graph is _____.

[MCQ: 2016]



Topological sorting

A B D C E F

A C E B D F

A B C D E F

A B C E D F

A C B E D F

A C B D E F

A X

B y

A B X y

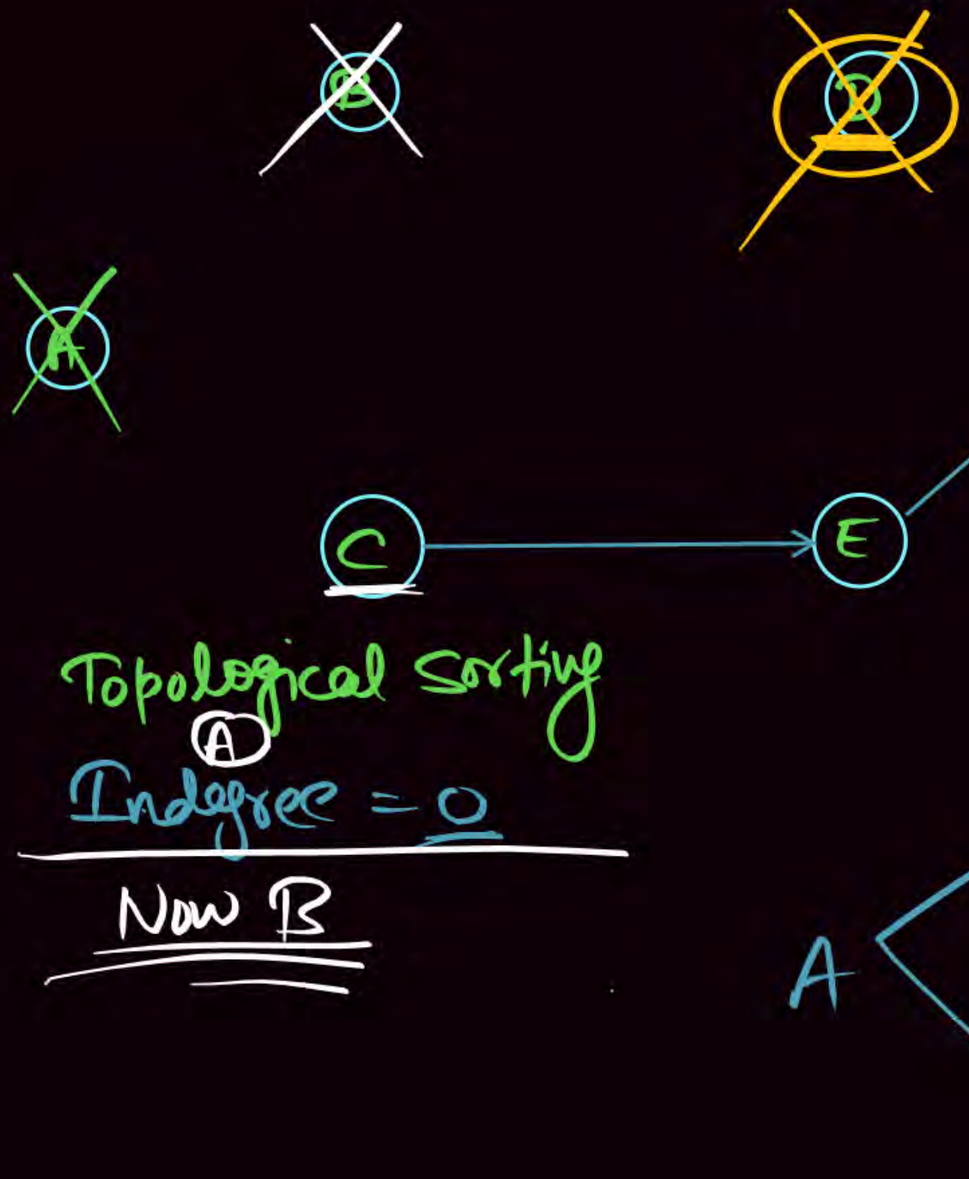
X y A B

A X B y

A X y B

X A y B

X A B y



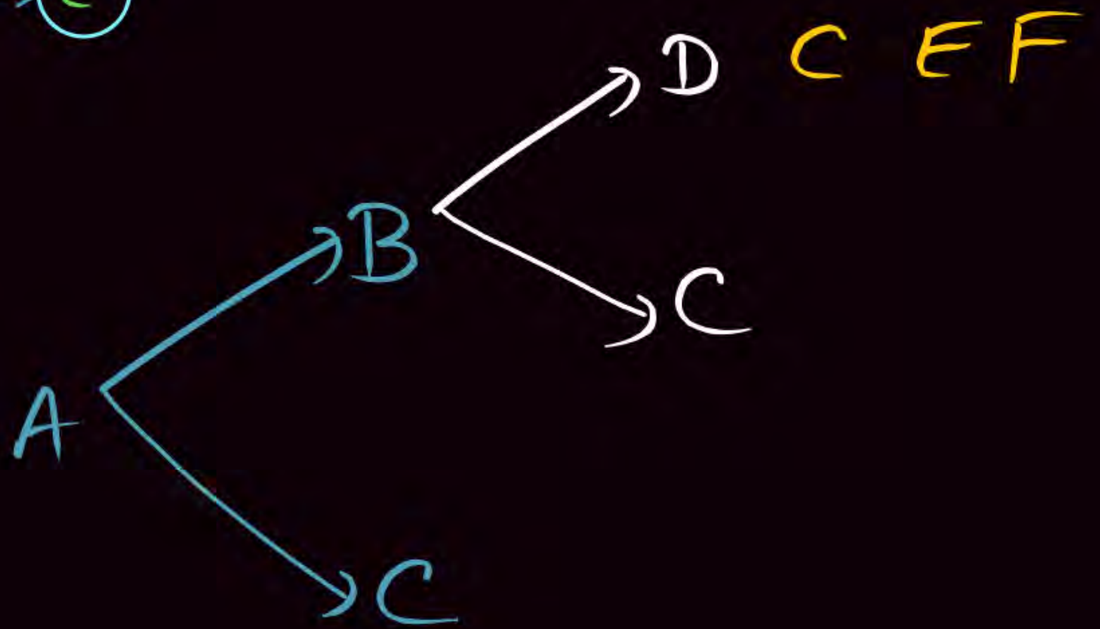
Now D

Topological sorting

A

Indegree = 0

Now B



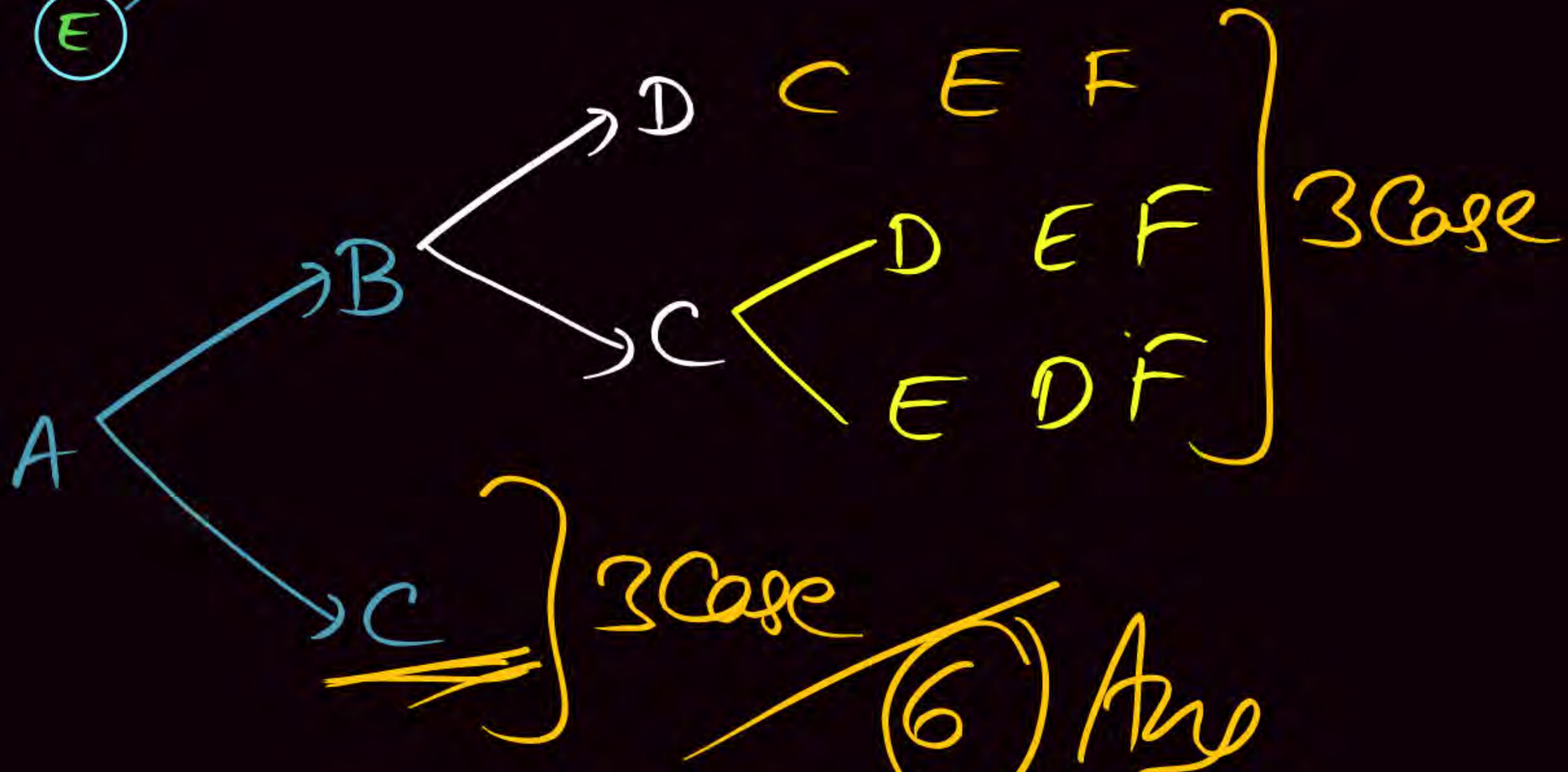
Topological sorting

(A)

Indegree = 0

Now B

Now C



MCQ Q.15

Consider a simple checkpointing protocol and the following set of operations in the log.
(start, T4); (write, T4, y, 2, 3); (start, T1);
(commit, T4); (write, T1, z, 5, 7);
(checkpoint);
(start, T2); (write, T2, x, 1, 9); (commit, T2);
(start, T3); (write, T3, z, 7, 2);
If a crash happens now and the system tries to recover using both undo and redo operations, what are the contents of the undo list and the redo list?

[GATE-2015-CS: 2M]

A. Undo: T3, T1; Redo: T2

B. Undo: T3, T1; Redo: T2, T4

C. Undo: none; Redo: T2, T4, T3, T1

D. Undo: T3, T1, T4; Redo: T2

THANK YOU!