

Schedules: SERIAL and SERIALIZABLE

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Definition of SCHEDULE

- The sequence of the read/write operations of several transactions as they are executed in the Database

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Serial Schedule

- Transactions execute fully.
- One at a time.
- No interleaving.
- Different orders of execution may produce different final values

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Serializable Schedule

- Interleaved.
- Equivalent to *SOME* serial schedule.
- Equivalence does NOT mean "ending up with the same values as".
- Equivalence cannot depend on initial values of database items.
- Cannot depend on values written
 - DB doesn't know logic of transaction.
- Depends only on order of operations.

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Conflicting Operations

- Used to define how schedules are equivalent
- 2 OPERATIONS CONFLICT if
 - belong to different transactions
 - access same data item
 - at least one is a write

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CONFLICT EQUIVALENCE

- 2 Schedules are Conflict Equivalent
- if the order of any 2 conflicting operations is the same in both schedules.
- SERIALIZABLE SCHEDULE is CONFLICT EQUIVALENT to some serial schedule

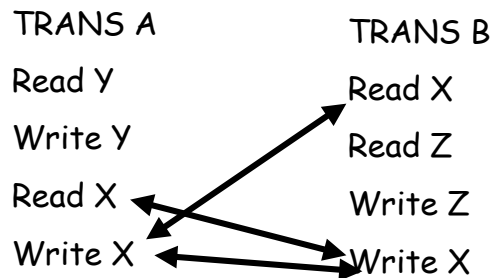
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Example of Conflict Equivalence

- Transaction A and Transaction B each Read and Write X.
- Conflicting Operations:
 - Trans A Read X and Trans B Write X
 - Trans A Write X and Trans B Read X
 - Trans A Write X and Trans B Write X

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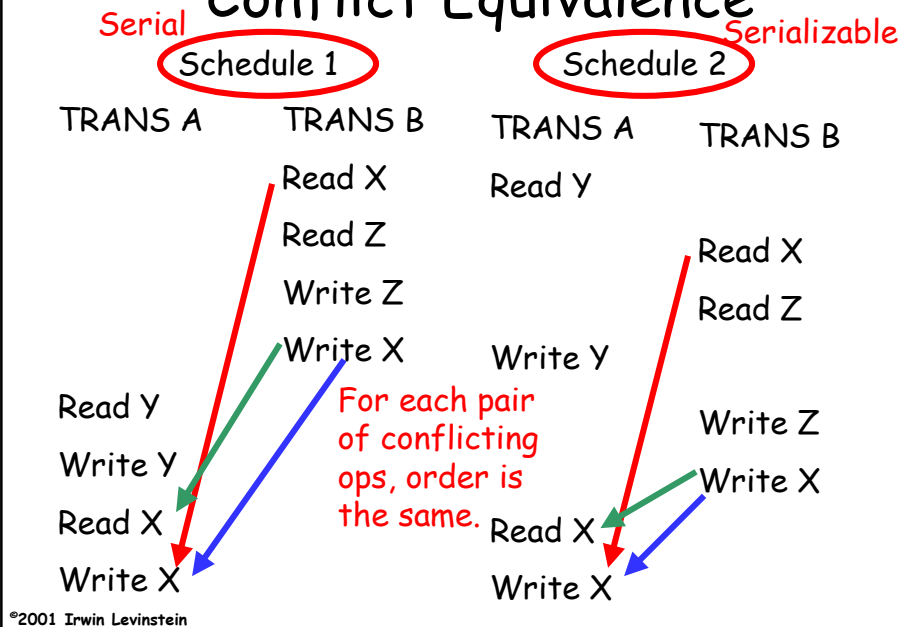
Conflicting Operations



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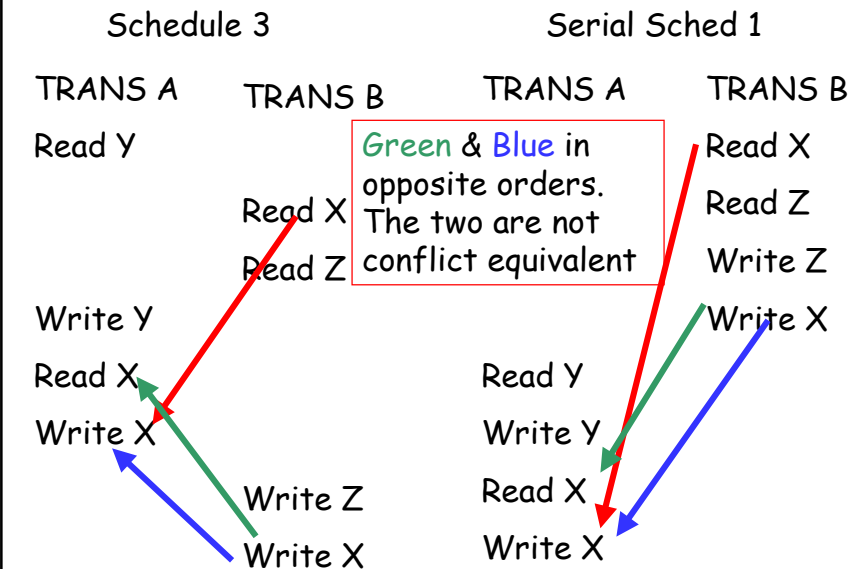
They are conflict equivalent!

Conflict Equivalence



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Is Schedule 3 Serializable?



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We are not done!

- Schedule 3 is not equivalent to one serial schedule.
 - Where Trans B precedes Trans A
- But it might be equivalent to another
 - Where Trans A precedes Trans B
- To be serializable, it needs to be equivalent to only one serial schedule.

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Is Schedule 3 Serializable? Again.

Schedule 3		Serial Sched 2	
TRANS A	TRANS B	TRANS A	TRANS B
Read Y		Read Y	
	Read X	Write Y	
	Read Z	Read X	
Write Y		Write X	
Read X			Read X
Write X			Read Z
	Write Z		Write Z
	Write X		Write X

Green in opposite orders.
The two are not conflict equivalent

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Serial Sched 2

TRANS B

Read y

Read X

Read Z

Write X

ers.

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Read X

Read Z

Write Z

Write X

Green in opposite orders.
The two are not conflict equivalent

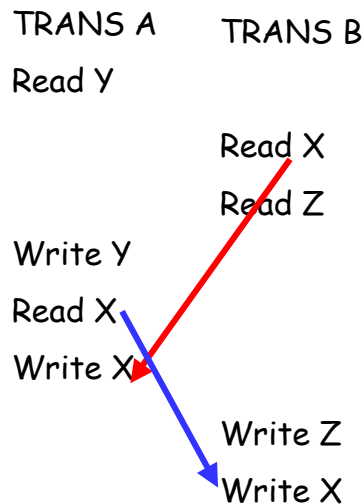
Conclusion

- Schedule 3 is not equivalent to serial schedule Trans A; Trans B.
- Schedule 3 is not equivalent to serial schedule Trans B; Trans A.
- There are no other Trans A/Trans B serial schedules.
- Schedule 3 is not serializable.

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A shorter way

Schedule 3



Trans B Read X **comes before** Trans A Write X. **If there is an equivalent serial schedule, it must be one where Trans B comes before Trans A.**

Trans A Read X **comes before** Trans B Write X. **If there is an equivalent serial schedule, it must be one where Trans A comes before Trans B.**

So there can be no equivalent serial schedule

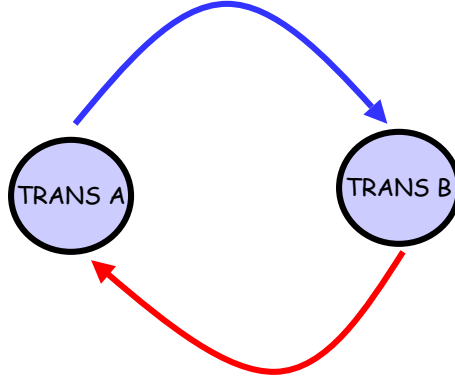
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A Graphical Representation

Schedule 3

TRANS A	TRANS B
Read Y	
	Read X
	Read Z
Write Y	
Read X	
Write X	
	Write Z
	Write X

Trans A Read X -- Trans B Write X



Trans B Read X -- Trans A Write X

Precedence Graph

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