

## Schedules: SERIAL and SERIALIZABLE

### Definition of SCHEDULE

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

## Serial Schedule

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

## 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.

## 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
- **IMPORTANT:** they do **NOT** have to **ACTUALLY** come into **CONFLICT!**
  - A better name would be 'Potentially Conflicting Operations'

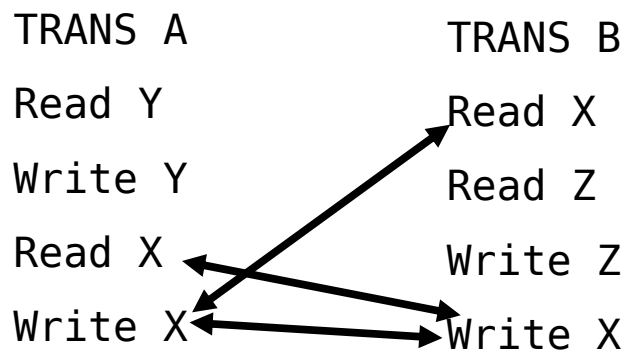
## CONFLICT EQUIVALENCE

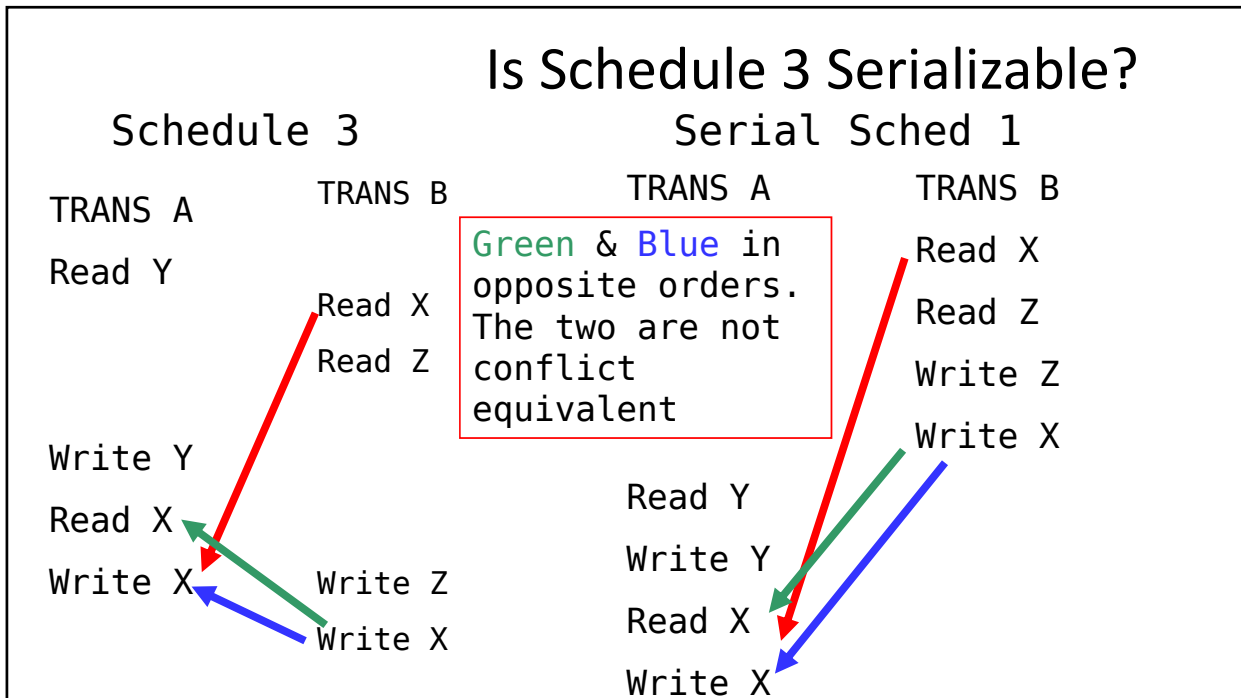
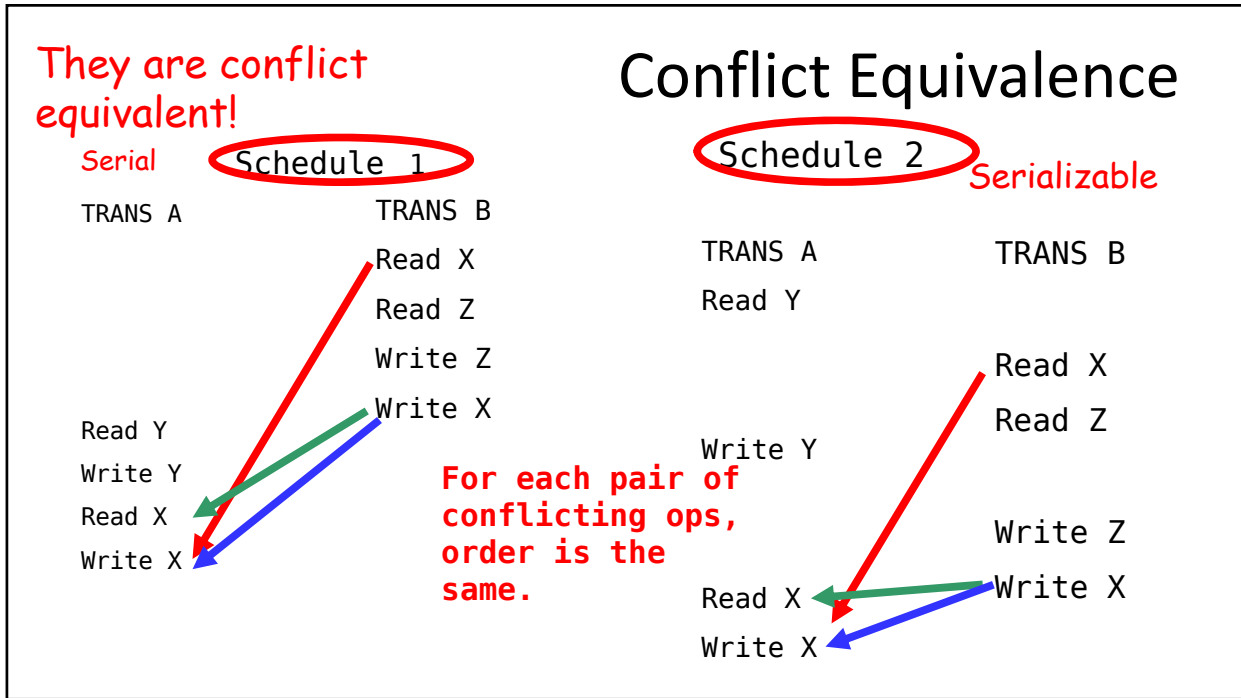
- 2 Schedules are Conflict Equivalent
- If the order of any 2 conflicting operations is the same in both schedules.
- SERIALIZABLE SCHEDULE is CONFLICT EQUIVALENT to some serial schedule

## 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
- Trans A Read X and Trans B Read X do not conflict

## Conflicting Operations

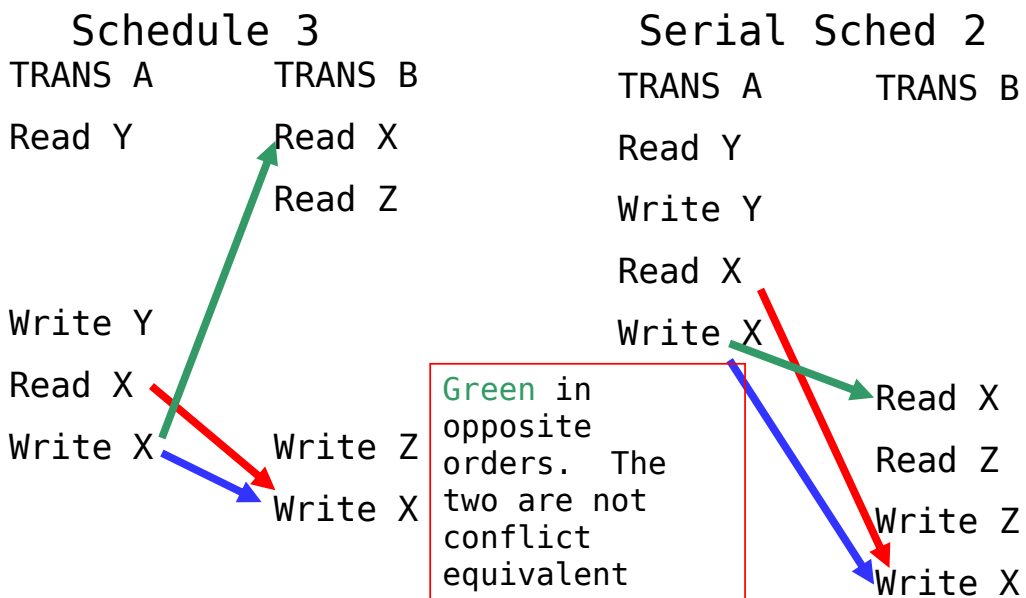




## We are not done!

- 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.

## Is Schedule 3 Serializable? Again.



## 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.

## A shorter way

### Schedule 3

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

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**

