Tutorial 9: Transaction

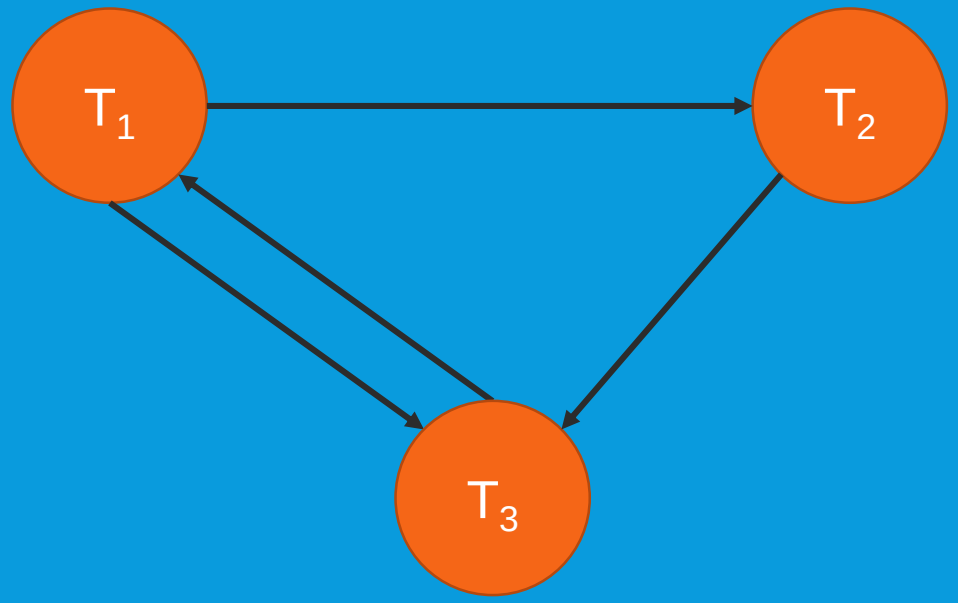
CS3402 Database Systems

Question 1

- Which of the following schedules is (conflict) serializable? For each serializable schedule, determine the equivalent serial schedules.
  a) $r_1(X); r_3(X); w_1(X); r_2(X); w_3(X);$
  b) $r_1(X); r_3(X); w_3(X); w_1(X); r_2(X);$
  c) $r_3(X); r_2(X); w_3(X); r_1(X); w_1(X);$

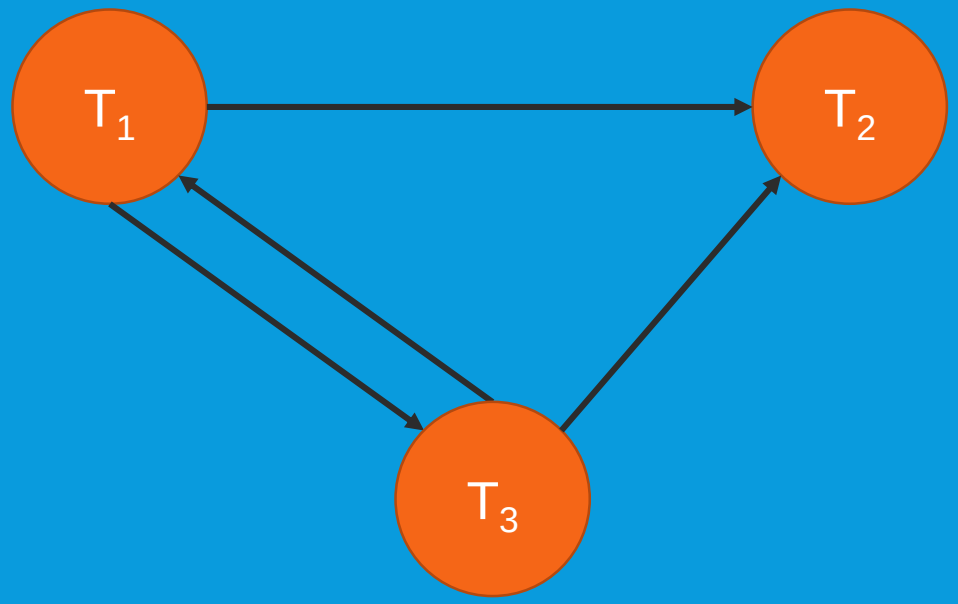
Question 1a (Answer)

- $r_1(X); r_3(X); w_1(X); r_2(X); w_3(X);$
- Conflict pairs:
  - $r_1(X); w_3(X);$
  - $r_3(X); w_1(X);$
  - $w_1(X); r_2(X);$
  - $w_1(X); w_3(X);$
  - $r_2(X); w_3(X);$
- Since the serialization graph is cyclic, this schedule is NOT conflict serializable.



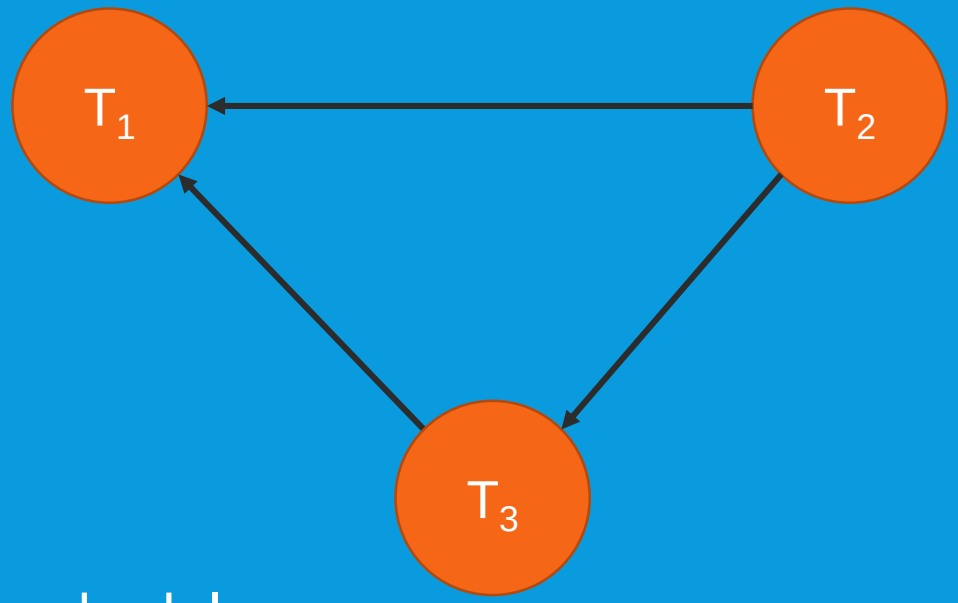
Question 1b (Answer)

- $r_1(X); r_3(X); w_3(X); w_1(X); r_2(X);$
- Conflict pairs:
  - $r_1(X); w_3(X);$
  - $r_3(X); w_1(X);$
  - $w_3(X); w_1(X);$
  - $w_3(X); r_2(X);$
  - $w_1(X); r_2(X);$
- Since the serialization graph is cyclic, this schedule is NOT conflict serializable.



Question 1c (Answer)

- $r_3(X)$; $r_2(X)$; $w_3(X)$; $r_1(X)$; $w_1(X)$;
- Conflict pairs:
  - $r_3(X)$; $w_1(X)$;
  - $r_2(X)$; $w_3(X)$;
  - $r_2(X)$; $w_1(X)$;
  - $w_3(X)$; $r_1(X)$;
  - $w_3(X)$; $w_1(X)$;



- Since the serialization graph is acyclic, this schedule is conflict serializable.
- It is equivalent to this serial schedule: $r_2(X)$; $r_3(X)$; $w_3(X)$; $r_1(X)$; $w_1(X)$; (or simply write T_2, T_3, T_1).

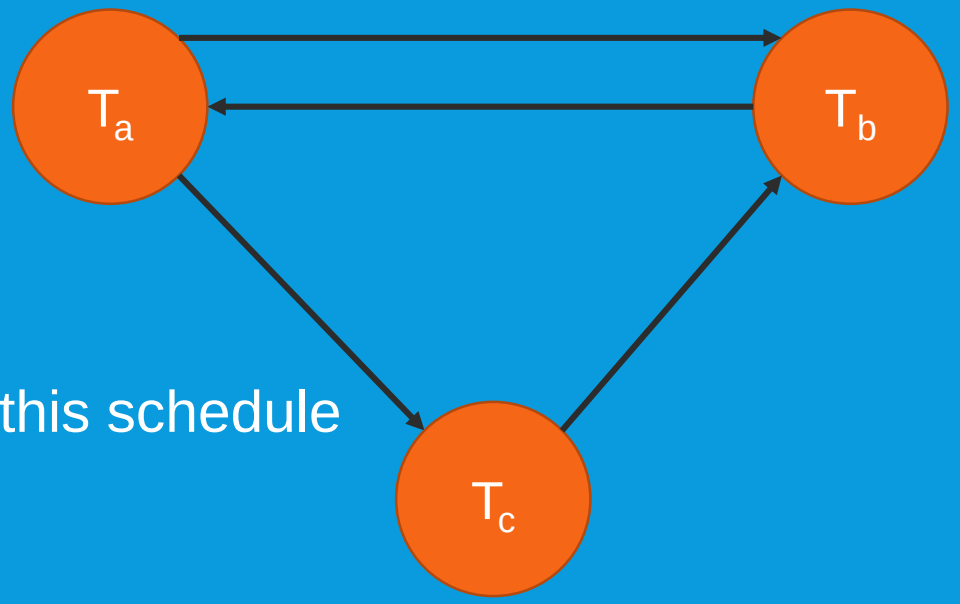
Question 2

- Consider the following concurrent schedule. Draw the serialization graph for the schedule. Is it conflict serializable?

T_a	T_b	T_c
	Read(x)	
Write(y)		
		Read(y)
	Write(y)	
Write(x)		
	Commit	
		Write(z)
Commit		
		Commit

Question 2 (Answer)

- $R_b(x)$; $W_a(y)$; $R_c(y)$; $W_b(y)$; $W_a(x)$; C_b; $W_c(z)$; C_a; C_c
- Conflict pairs
  - $R_b(x)$; $W_a(x)$;
  - $W_a(y)$; $R_c(y)$;
  - $W_a(y)$; $W_b(y)$;
  - $R_c(y)$; $W_b(y)$;
- Since the serialization graph is cyclic, this schedule is NOT conflict serializable.



Question 3

- Consider schedules S_1, S_2 and S_3 below. Determine whether each schedule is strict, cascadeless, recoverable, or nonrecoverable. Determine the strictest recoverability condition that each schedule satisfies.

  a) $r_1(X); w_1(X); r_2(X); r_1(Y); w_2(X); c_2; c_1;$

  b) $r_1(X); w_1(X); r_2(X); r_1(Y); w_2(X); w_1(Y); c_1; c_2;$

  c) $r_1(X); w_1(X); w_2(X); w_1(Y); c_1; r_2(X); c_2;$

  Can you change c) into a strict schedule?

Types of Schedules (1/2)

- A unrecoverable schedule is one where, a dirty read takes place.
- A recoverable schedule is one where, if some transaction T_j is reading value updated or written by some other transaction T_i, then the commit operation of T_j must appear after the commit operation of T_i.
- A cascadeless schedule is one where, for each pair of transactions T_i and T_j such that T_j reads data items previously written by T_i, the commit operation of T_i appears before the read operation of T_j. Cascadeless schedules are desirable because the failure of a transaction does not lead to the aborting of any other transaction.

Types of Schedules (2/2)

- A strict schedule is one where for any two transactions T_i and T_j, if a write operation of T_i appears before a conflicting operation of T_j (either read or write), then the commit or abort operation of T_i also appears before that conflicting operation of T_j.

Question 3a (Answer)

- $r_1(X)$; $w_1(X)$; $r_2(X)$; $r_1(Y)$; $w_2(X)$; c_2; c_1;
- Non-recoverable schedule
- T_2 (i.e., $R_2(X)$) read uncommitted data item X written by T_1 (i.e., dirty read)

Question 3b (Answer)

- $r_1(X)$; $w_1(X)$; $r_2(X)$; $r_1(Y)$; $w_2(X)$; $w_1(Y)$; c_1; c_2;
- Recoverable schedule (i.e., no dirty read)

Question 3c (Answer)

- $r_1(X)$; $w_1(X)$; $w_2(X)$; $w_1(Y)$; c_1; $r_2(X)$; c_2;
- Cascadeless schedule
- T_2 reads data item X previously written by T_1 and the commit operation of T_1 appears before the read operation of T_2.
- Strict schedule: $r_1(X)$; $w_1(X)$; $w_1(Y)$; c_1; $w_2(X)$; $r_2(X)$; c_2;