Exercise 9

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1 Serializability

T_1

```
read  (x)
write (b)
read  (c)
write (x)
```

T_2

```
read  (d)
read  (a)
write (y)
```

T_3

```
read  (a)
read  (b)
write (a)
write (b)
write (x)
```

The transactions T_1, T_2 and T_3 shall be executed concurrently. For this purpose a database management system utilizing the two-phase locking protocol is used. The transactions are processed using a round-robin strategy $(T_1, T_2, T_3, T_1, ...)$, which executes one transaction step for a transaction T_i at a time.

Transaction step

1. Retrieve the next `read/write` operation `op(X)` of T_i.
2. If T_i does not hold the lock for `X`: `lock(X)`.
3. Execute `op(X)`.
4. Enter the release-phase as soon as possible and perform for each object `Y`, not used by T_i anymore, `unlock(Y)`.

If a lock can not be granted for a transaction, the transaction step will be aborted and the transaction acquires the lock in the next regular step where the lock is free.

Assignments

1. Determine the schedule S the DBMS is going to use in order to execute the transactions.
2. Determine all conflicts in the conflict relation of S.
3. To which serial plan is S conflict-equivalent?

2 Classes of Schedules

Let

- S_{ser} denote the set of all serial schedules.
- S_{csb} denote the set of all conflict-serializable schedules.
- S_{2PL} denote the set of all schedules which can be generated by a 2PL scheduler.

Two sets can be in various relationships to each other, for example by inclusion ($S_x \subset S_y$), non-empty intersection ($S_x \cap S_y \neq \emptyset$) or disjunction ($S_x \cap S_y = \emptyset$).

Show for each of the following pairs how the relate to each other.

1. S_{ser} and S_{csb}
2. S_{csb} and S_{2PL}