1 Serializability

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 $\text{op}(X)$ of $T_i$.
2. If $T_i$ does not hold the lock for $X$: $\text{lock}(X)$.
3. Execute $\text{op}(X)$.
4. Enter the release-phase as soon as possible and perform for each object $Y$, not used by $T_i$ anymore, $\text{unlock}(Y)$.

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 $S_{2PL}$