1. (45 points) Analyzing schedules

For each of the following schedules, state which of the following properties hold: conflict serializable, recoverable, cascadeless, or strict. A schedule is strict if a value written by a transaction T is not read or overwritten by other transactions until T either aborts or commits.

Please display your answer as a table with one row per schedule, and one column per property. Indicate the satisfied properties with a check mark.

**Reminder**: a conflict serializable schedule is one that has no conflicting operations amongst its committed transactions. Aborted transactions are ignored when determining conflict serializability.

(a) T1:W(X), T2:R(X), T1:W(X), T2:Commit, T1:Commit
(b) T1:R(X), T2:W(X), T1:W(X), T2:Abort, T1:Commit
(c) T1:R(X), T2:R(X), T1:W(X), T1:Commit, T2:W(X), T2:Commit
(d) T1:R(X), T2:W(X), T1:W(X), T2:Commit, T1:Commit
(e) T1:W(X), T2:R(X), T1:W(X), T2:Commit, T1:Abort
(f) T1:R(X), T2:R(X), T1:Commit, T2:W(X), T2:Commit
(g) T1:W(X), T2:R(Y), T1:R(Y), T2:R(X), T1:Commit, T2:Commit
2. (30 points) Locking

(a) Consider the following schedule:

T1:R(A), T1:W(A), T2:R(A), T2:W(A), T2:R(B), T2:W(B), T2:Commit, T1:Abort

i. Is this schedule allowed by Two Phase Locking? If not explain why. If so, show the schedule with lock requests and releases obeying 2PL.

ii. Is this schedule allowed by Strict Two Phase Locking? If not explain why. If so, show the schedule with lock requests obeying Strict 2PL.

(b) We call a transaction that only reads database objects a read-only transaction. Otherwise the transaction is called a read-write transaction. Give brief answers to the following questions:

i. What is lock thrashing and when does it occur?

ii. What happens to the database system throughput if the number of read-write transactions is increased?

iii. What happens to the database system throughput if the number of read-only transactions is increased?

iv. Describe three ways of tuning your system to increase transaction throughput.