Transaction Processing

Problem 1

Consider the four transactions, T_1, T_2, T_3, and T_4, which are in schedule S_1. Draw the serializability (precedence) graphs for S_1, and state whether the schedule is serializable or not. If the schedule is serializable, write down the equivalent serial schedule(s). If it is not, write down all cycles. Note that S_1 is shown both as an operation list and as a table.

$T_1 = r_1(X),\ w_1(X)$
$T_2 = r_2(X),\ w_2(Y)$
$T_3 = r_3(X),\ w_3(Z)$
$T_4 = r_4(Y),\ w_4(Z)$

$S_1 = r_1(X);\ w_1(X);\ r_2(X);\ w_2(Y);\ r_3(X);\ w_3(Z);\ r_4(Y);\ w_4(Z)$

T1	T2	T3	T4
read(X)			
write(X)			
	read(X)		
	write(Y)		
		read(X)	
		write(Z)	
			read(Y)
			write(Z)

Problem 2

Consider the three transactions T_1, T_2, and T_3, and the schedules S_1 and S_2 given below. Draw the serializability (precedence) graphs for S_1 and S_2, and state whether each schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s).

T_1: $r_1(X)$; $r_1(Z)$; $w_1(X)$;
T_2: $r_2(Z)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;
T_3: $r_3(X)$; $r_3(Y)$; $w_3(Y)$;

S_1: $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $w_3(Y)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;
S_2: $r_1(X)$; $r_2(Z)$; $r_3(X)$; $r_1(Z)$; $r_2(Y)$; $r_3(Y)$; $w_1(X)$; $w_2(Z)$; $w_3(Y)$; $w_2(Y)$;

S1

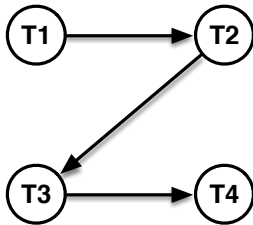| T1	T2	T3
read(X)		
	read(Z)	
read(Z)		
		read(X)
		read(Y)
write(X)		
		write(Y)
	read(Y)	
	write(Z)	
	write(Y)	

S2

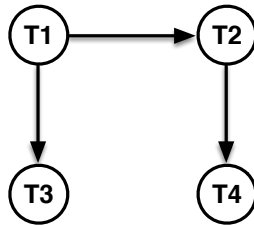| T1	T2	T3
read(X)		
	read(Z)	
		read(X)
read(Z)		
	read(Y)	
		read(Y)
write(X)		
	write(Z)	
		write(Y)
	write(Y)	

Problem 3

Given the following eight precedence graphs, determine the serializability of each. If a graph is serializable, draw all equivalent serial graphs. If a graph is not serializable, draw all cycles.
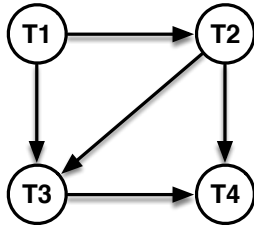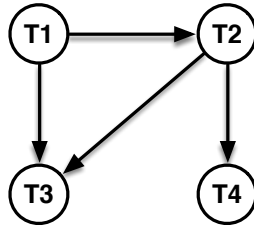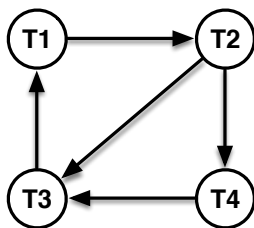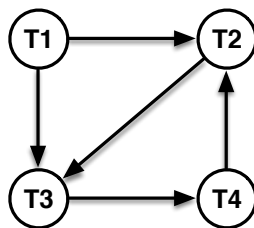
(a)

T1 → T2
T2 → T3
T3 → T4

(b)

T1 → T2
T1 → T3
T2 → T4

(c)

T1 → T2
T1 → T3
T2 → T3
T2 → T4
T3 → T4

(d)

T1 → T2
T1 → T3
T2 → T3
T2 → T4

(e)

T1 → T2
T3 → T1
T2 → T3
T2 → T4
T4 → T3

(f)

T1 → T2
T1 → T3
T3 → T2
T4 → T2
T3 → T4

(g)

T1 → T2
T1 → T3
T1 → T4
T2 → T4
T3 → T4
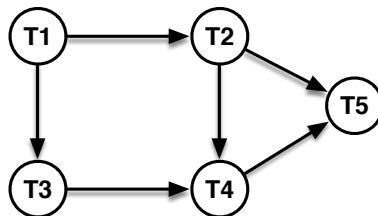
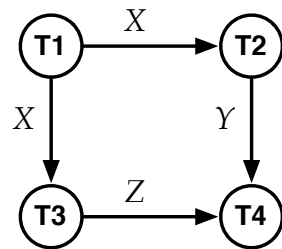**(h)**

T1 → T2
T1 → T3
T2 → T5
T2 → T4
T3 → T4
T4 → T5
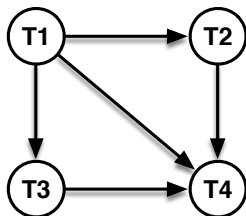
ANSWER KEY
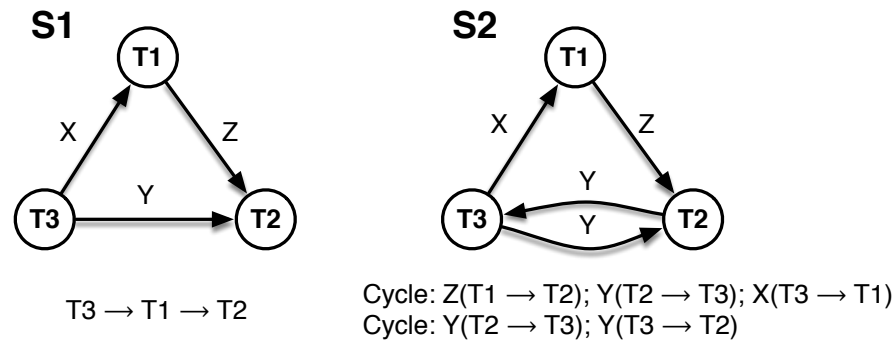
Problem 1

Serializability Graph

Equivalent Serial Schedules
$$T_1 \rightarrow T_2 \rightarrow T_3 \rightarrow T_4$$
$$T_1 \rightarrow T_3 \rightarrow T_2 \rightarrow T_4$$

Problem 2

S1

$T3 \rightarrow T1 \rightarrow T2$

S2

Cycle: Z(T1 → T2); Y(T2 → T3); X(T3 → T1)
Cycle: Y(T2 → T3); Y(T3 → T2)

Justification – The red arrows in the tables below are informational purposes. Such notation will not be required on the Exam. Only the precedence graphs above will be required, along with equivalent serial schedule (if serializable) or cycles (if non-serializable).
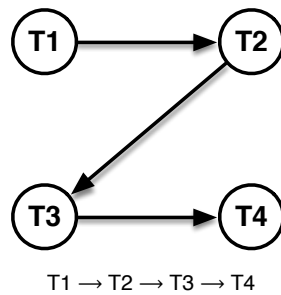
S1

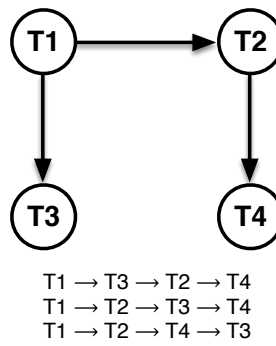| T1	T2	T3
read(X)		
	read(Z)	
read(Z)		
		read(X)
		read(Y)
write(X)		
		write(Y)
	read(Y)	
	write(Z)	
	write(Y)	

S2

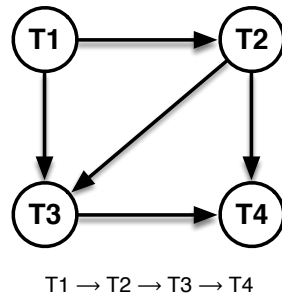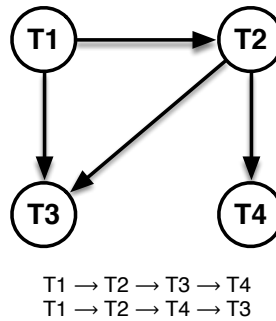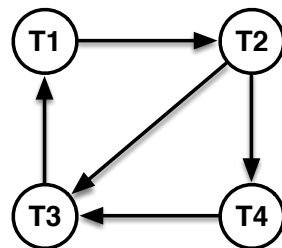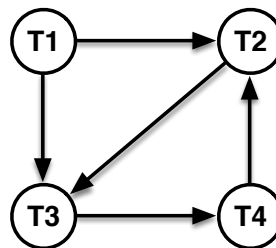| T1	T2	T3
read(X)		
	read(Z)	
		read(X)
read(Z)		
	read(Y)	
		read(Y)
write(X)		
	write(Z)	
		write(Y)
	write(Y)	

Problem 3

(a)

T1 → T2 → T3 → T4

(b)

T1 → T3 → T2 → T4
T1 → T2 → T3 → T4
T1 → T2 → T4 → T3

(c)

T1 → T2 → T3 → T4

(d)

T1 → T2 → T3 → T4
T1 → T2 → T4 → T3

(e)

Cycle: (T1→T2), (T2→T3), (T3→T1)

(f)

Cycle: (T2→T3), (T3→T4), (T4→T2)

(g)

T1 → T2 → T3 → T4
T1 → T3 → T2 → T4

(h)

T1 → T3 → T2 → T4 → T5
T1 → T2 → T3 → T4 → T5