COMP9311 Assignment 1 Haojin, Guo z5216214 17, Nov, 2020

Question 1,

(1)

$A \rightarrow I \in F^+$ iff $I \subseteq A^+$

Thus, need to compute $\{A\}^+$

1^{st} scan of A:

$A^+ := \{A\}$

$A^+ := \{A, B, C\}$

2^{nd} scan of A:

$A^+ := \{A, B, C\}$no change, therefore the algorithm terminates.

$A^+ := \{A, B, C\}$, but $I \nsubseteq A^+$

Therefore, $A \rightarrow I \notin F^+$

(2)

X = {A, C, D, E, H,G} can be considered as a super key,

because $\{A, C, D, E, H, G\}^+ = \{A, B, C, D, E, G, H, I, J\}$ but the attribute G is not in FD set.

Then, find a candidate key,

A can be removed because $\{C, D, E, H, G\}^+ = \{A, B, C, D, E, G, H, I, J\} = F$,

(from CD →AE)

E also can be removed because $\{C, D, H, G\}^+ = \{A, B, C, D, E, G, H, I, J\} = F$,

(from CD →AE)

H can be further removed because $\{C, D, G\}^+ = \{A, B, C, D, E, G, H, I, J\} = F$,

(from CD →AE, E→CHI, H→J)

C can not be removed because $\{D, G\}^+ = \{D, G\} \neq F$

Similarly D,G can not be removed.

Therefore, CDG is a candidate key. (And the another candidate key is EDG.)

(3)

The highest normal form is 1NF.

(i) In the FD set, for example, CD →AE, E→CHI, H→J, it is found that attributes E and H are transmit module, so it's transitive functional dependency, not 3NF.

(ii) When CDG chosen as the candidate key, CDG →AE can be written as CD →AE, so there is a partial dependency , not 2NF.

(iii) R(U) satisfy atomicity

Therefore, the highest normal form of R with respect to F is 1NF.

(4)

F_m = {A→B, A→C, CD→A, CD→E, E→C, E→H, E→I, H→J}

Step1: $F_m = F$

Step2: Replace A→BC with A→B, A→C.

Replace CD→AE with CD→A, CD→E.

Replace E→CHI with E→C, E→H, E→I.

Step3: C, D both can not be removed.
Step4: There are no redundant relations. No more FD could be removed, done.

(5)
The minimum cover is as above,
$F_m = \{A \rightarrow B, A \rightarrow C, CD \rightarrow A, CD \rightarrow E, E \rightarrow C, E \rightarrow H, E \rightarrow I, H \rightarrow J\}$
Meanwhile, Candidate key: (C, D, G)
Then, it can be decomposed as below.
R1' = (A, B)
R2' = (A, C)
R3' = (C, D, A)
R4' = (C, D, E)
R5' = (E, C)
R6' = (E, H)
R7' = (E, I)
R8' = (H, J)
None of relation contains a key of G, thus,
R9' = (C, D, G)

Here, R1' and R2' can be merged as (A, B, C),
Similarly R3' and R4', R5' , R6' and R7' , are also can be merged.

Therefore, the final decomposed relations are,
R1 = (A, B, C)
R2 = (C, D, A, E)
R3 = (E, C, H, I)
R4 = (H, J)
R5 = (C, D, G)

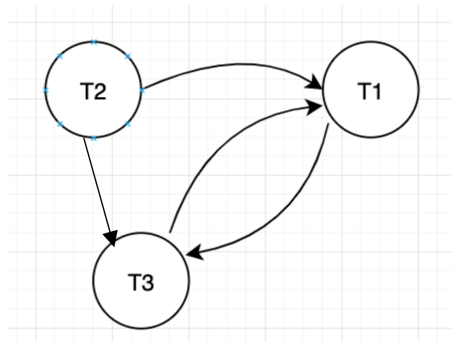
Question 2,

(1) Not serializable.

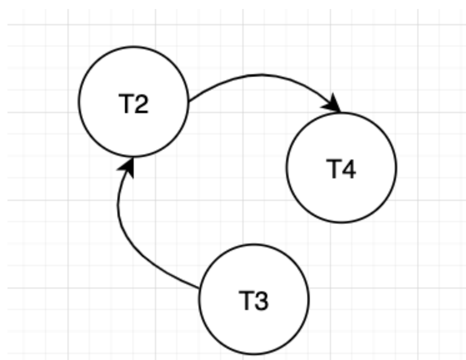
Precedence graph for this schedule:

Draw graphs separately based on the three values of A, B and C.

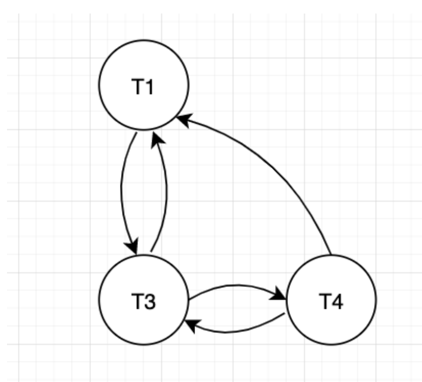
(i)For A:



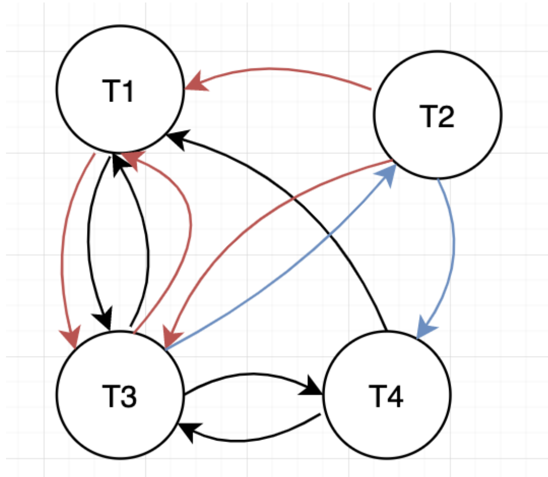
(ii)For B:



(iii)For C:



Put (i)(ii)(iii) together:



Has cycles according to the graphs above, therefore, this transaction schedule not serializable

(2)

Time	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11	t12	t13	t14	t15	t16	t17	t18
T1	R(A)	R(C)	W(A)	W(C)														
T2					R(A)	W(A)	R(B)	W(B)										
T3									R(B)	R(C)	R(A)	W(C)	W(B)	W(A)				
T4															R(C)	W(C)	R(B)	W(B)

(3)

Time	T1	T2
1		Write_lock(A)
2		Read_item(A)
3		Write_item(A)
4		Unlock(A)
5	Write_lock(A)	
6	Read_item(A)	
7	Write_lock(C)	
8	Read_item(C)	
9	Write_item(A)	
10	Unlock(A)	
11	Write_item(C)	
12	Unlock(C)	
13		Write_lock(B)

14		Read_item(B)
15		Write_item(B)
16		Unlock(B)