COMP9311 Final Exam Submission
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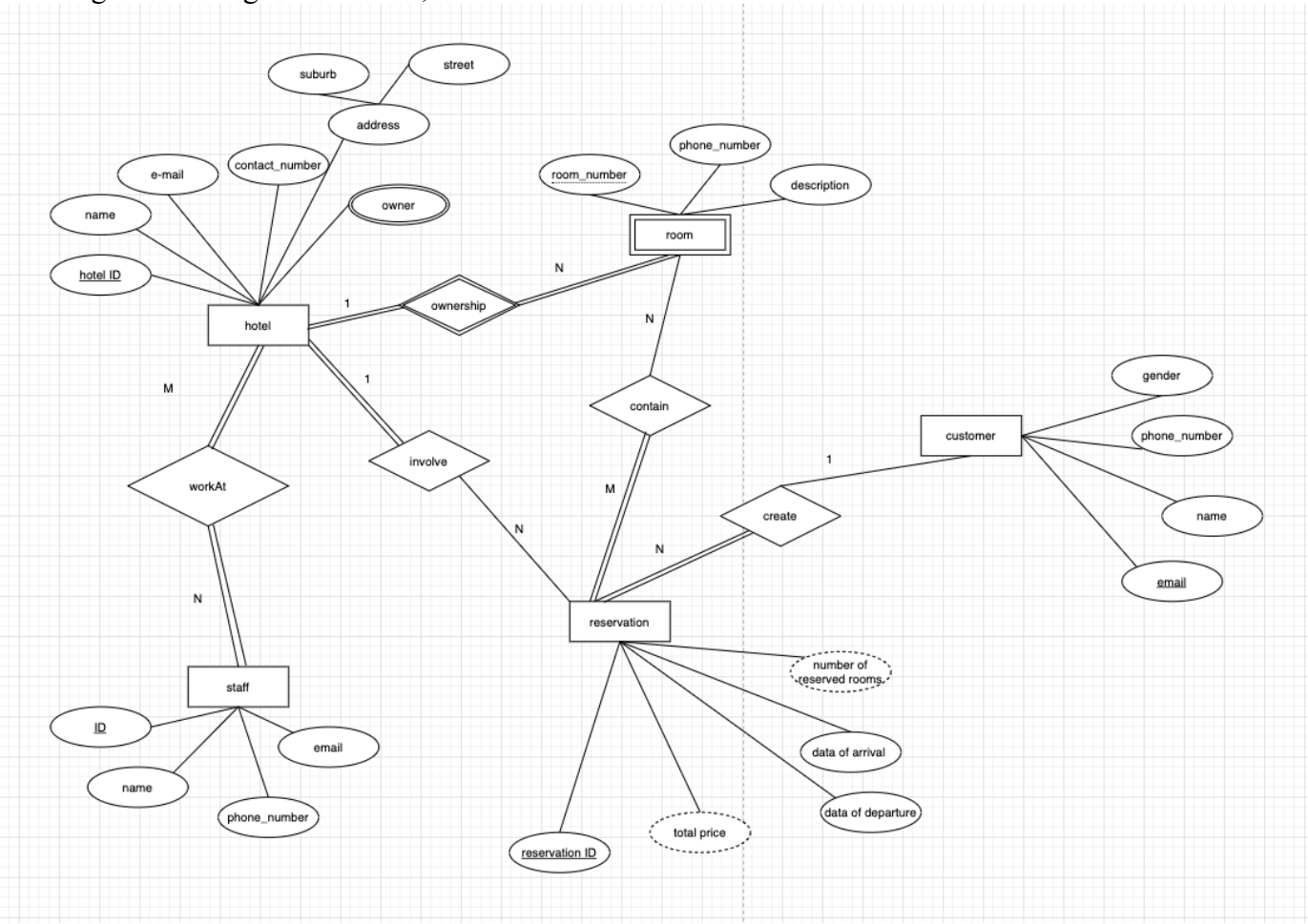
Question1:
(1) False
(2) False
(3) False
(4) False...
(5) True…
(6) True
(7) False
(8) False
(9) True
(10) False

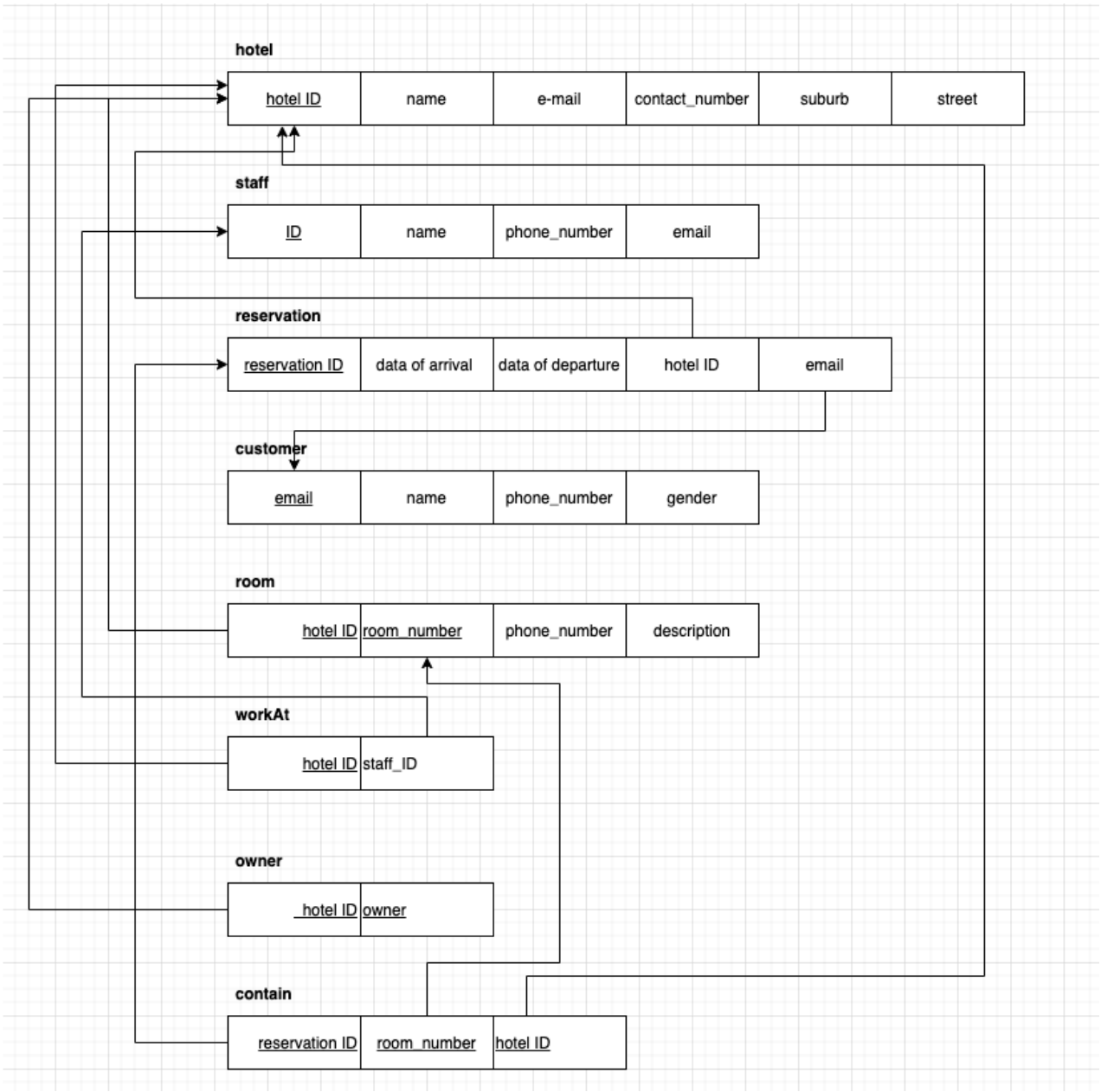
Question2:

(a)
Drawing the ER diagram as below,



(b)

Convert ER-diagram from (a) in to RM-diagram(relational data model) is shown as below.



Question3:
(a)

1.

F = {BD → CH, BC → HI, EI → H, H → AB, I → E, EJ→ I}

Step1: F' = {BD → C, BD → H, BC → I, BC → H, EI → H, EJ→ I, H → A, H → B, I → E}

Step2:
(i)BD → C
B^+ = {B}, thus B → C is not inferred by F'.
D^+ = {D}, thus D → C is not inferred by F'.
Hence BD → C cannot be replaced by B → C or D → C.
Similar, BD → H cannot be replaced by B → H or D → H.
(ii) BC → I
B^+ = {B}, thus B → I is not inferred by F'.
C^+ = {C}, thus C → I is not inferred by F'.
Hence, BC → I cannot be replaced by B → I or C → I.
Similar, BC → H cannot be replaced by B → H or C → H
(iii) for EI → H
E^+ = {E}, thus E → H is not inferred by F'.
I^+ = {I, E, H, A, B,}, thus I → H is inferred by F'.
Hence, I → H can replace EI → H.
Similar, EJ→ I cannot be replaced by E→ I or J→ I;
Therefore,
F'' = {BD → C, BD → H, BC → I, BC → H, I → H, I → E, EJ→ I, H → A, H → B}
Step3:
$BD^+ \mid_{F'' - (BD \to C)}$ = {B, D, H, A, B} is not inferred by $F'' - (BD \to C)$, not redundant
$BD^+ \mid_{F'' - (BD \to H)}$ = {B, D, C, I, H, A, B} is inferred by $F'' - (BD \to H)$, redundant
$BC^+ \mid_{F'' - (BC \to I)}$ = {B, C, H, A, B} is not inferred by $F'' - (BC \to I)$, not redundant
$BC^+ \mid_{F'' - (BC \to H)}$ = {B, C, I, H, E,} is inferred by $F'' - (BC \to H)$, redundant
$I^+ \mid_{F'' - (I \to H)}$ = {I, E} is not inferred by $F'' - (I \to H)$, not redundant
$I^+ \mid_{F'' - (I \to E)}$ = {I, H, A, B,} is not inferred by $F'' - (I \to E)$, not redundant
$EJ^+ \mid_{F'' - (EJ \to I)}$ = {E, J} is not inferred by $F'' - (EJ \to I)$, not redundant
$H^+ \mid_{F'' - (H \to A)}$ = {H, B} is not inferred by $F'' - (H \to A)$, not redundant
$H^+ \mid_{F'' - (H \to B)}$ = {H, A} is not inferred by $F'' - (H \to B)$, not redundant

Therefore, the minimal cover Fm for F is:
Fm = F''' = {BD → C, BC → I, I → H, I → E, EJ→ I, H → A, H → B}

2.

R = R (A, B, C, D, E, G, H, I, J)
According to Fm above, candidate key can get from the permutation and combination between {D, J, G} and {B, C, E, H, I}.

Step:
DGJ^+ = {DGJ} is not a candidate key;

Step2:
$DGJB^+$ = {D, G, J, B, C, I, H, A, E} = R, is a candidate key.
$DGJC^+$ = {D, G, J, C}} is not a candidate key
$DGJE^+$ = {D, G, J, E, I, H, E} is not candidate key
$DGJH^+$ = {D, G, J, H, A, B, } is not candidate key
$DGJI^+$ = {D, G, J, I, H, E, A, B, C}= R, is a candidate key
Step3:
$DGJCE^+$ = {D, G, J, C, E} , is a candidate key.
$DGJCH^+$ = {D, G, J, C, H, A, B, I, E} = R, is a candidate key

$DGJEH^+$ = {D, G, J, E, H, A, B, C, I}

Therefore, the list of candidate key of R with respect to F include:
DGJB, DGJI, DGJCH, DGJEH

3.
No,
The decomposition R1, and R2 of R is not satisfy lossless-join.
The initial of table is as below:

Decomposition	A	B	C	D	E	G	H	I	J
R_1 ={ABCDH}	a	a	a	a	b	b	a	b	b
R_2 = {EGHIJ}	b	b	b	b	a	a	a	a	a

The final state of the table.

Decomposition	A	B	C	D	E	G	H	I	J
R_1 ={ABCDH}	a	a	a	a	**a**	b	a	**a**	b
R_2 = {EGHIJ}	**a**	**a**	b	b	a	a	a	a	a

4.
(i) 1NF.
Not satisfy 3NF, because, there is a transitive functional dependency, for example, BC → I, I → H.
Not satisfy 2NF, the full function of each non-primary attribute that is not satisfied in f depends on the candidate key.
Therefore, the highest normal form of R is 1NF.
(ii)

For R= F = {BD → CH, BC → HI, EI → H, H → AB, I → E, EJ→ I}
Consider BD → CH, BD is not a superkey, split R into R1 {B, D, C, H} and R2{B, D, A, E, G, I, J}
Consider H → AB in R1 {B, D, C, H}, H is not a superkey, split R1 into R11{H, A, B} and R12{H, C};
Consider EJ→ I in R2{B, D, A, E, G, I, J}, EJ is not a superkey, split R2 into R21{E, J, I}and R22{B, D, A, E, J, G};
Therefore, one of the possible lossless-join decomposition to BCNF is R11, R12, R21, R22,

(b)

1. R← Park ⋈ Visit

   A← $\pi_{\{pID\}}$(Park)

   B ← $\gamma_{pID,\ COUNT(vID)}$(R)

   C ← $\gamma_{sum(pID)}$ (B/A)

2.

A ← Park ⋈ Visitor ⋈Visit

B ← π{pID, name}(σ (age >=65) (A))

C ← π{pID, name}(σ (age <=65) (A))

D ← π{name}(B + C)

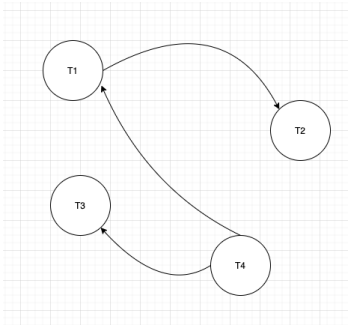
3.

4.

Question4:

(a)

1.



2.

This is serializable.

The equivalent serial schedule.

time	t1	t2	t3	t4	t5	t6	t7	t8	t9
T1			W(Y)	R(Y)	R(X)				
T2						R(Y)	W(Z)		
T3								R(Y)	R(X)
T4	W(Y)	W(X)							

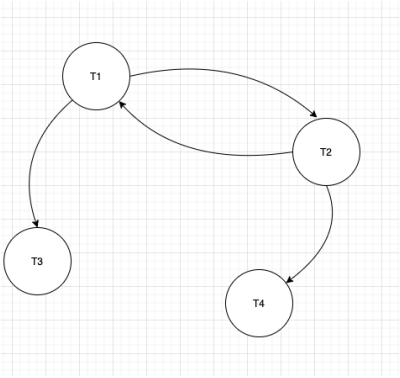
3.

time	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11	t12	t13	t14	t15
T1			W(Y)	R(Y)	R(X)										
T2						R(Y)	W(Z)								
T3								R(Y)	R(X)						

T4	W(Y)	W(X)													
T5										R(A)	W(B)	R(B)			
T6													R(A)	W(A)	W(B)

(b)

1.



Has cycle, not serializable

2. There is no deadlock.

According to the result of the previous question, the transaction of A and B exists conflict. When WL(A) in T2, T1 has completed the process of unlocking process (UL(A)). Therefore, no deadlock exists.

(C)

Time	T1	T2	T3	T4
1	Write_lock(Y)			
2	w1(Y)			
3	Read_lock(Y)			
4	r1(Y)			
5	Unlock(Y)			
6		Write_lock(X)		
7		w2(X)		
8		Read_lock(Z)		
9		r2(Z)		
10		Unlock(X)		
11			Read_lock(Z)	
12			r3(Z)	
13				Read_lock(X)
14				r4(X)

15				Write_lock(X)
16				w4(X)
17				Unlock(X)

Question5:
(a)
(i)
queries:
Q1: read 1, 2, 3, 4
Q2: read 1, 2, 3, 4
Q3: read 1, 2, 3, 4
Buffer: 3 pages
For LRU/FIFO:

	Q1				Q2				Q3			
buffer 1	1	2	3	4	1	2	3	4	1	2	3	4
buffer 2		1	2	3	4	1	2	3	4	1	2	3
buffer 3			1	2	3	4	1	2	3	4	1	2
F = 12	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

For MRU:

	Q1				Q2				Q3			
buffer 1	1	2	3	4	1	2	3	4	1	2	3	4
buffer 2		1	2	2	4	1	1	3	4	4	2	3
buffer 3			1	1	2	4	4	1	3	3	4	2
F =6	Y	Y	Y	Y			Y			Y		

MRU performs the best in this case.
(ii)
query
Q: 9, 5, 1, 0, 5, 6, 5, 6

Buffer: 3 pages

(i) For LRU:

query	**9**	**5**	**1**	**0**	**5**	**6**	**5**	**6**
buffer 1	9	5	1	0	5	6	5	6
buffer 2		9	5	1	0	5	6	5
buffer 3			9	5	1	0	0	0
F= 5	Y	Y	Y	Y		Y		

(ii) For FIFO:

query	**9**	**5**	**1**	**0**	**5**	**6**	**5**	**6**
buffer 1	9	5	1	0	0	6	5	5
buffer 2		9	5	1	1	0	6	6
buffer 3			9	5	5	1	0	0
F= 6	Y	Y	Y	Y		Y	Y	

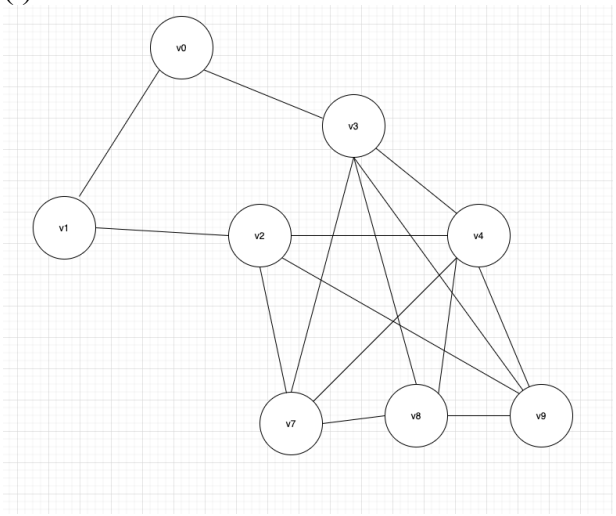
(iii)For MRU:

query	**9**	**5**	**1**	**0**	**5**	**6**	**5**	**6**
buffer 1	9	5	1	0	5	6	5	6
buffer 2		9	5	5	0	0	0	5
buffer 3			9	9	9	9	9	0
F= 7	Y	Y	Y	Y		Y	Y	Y

In this case, LRU > FIFO > MRU:

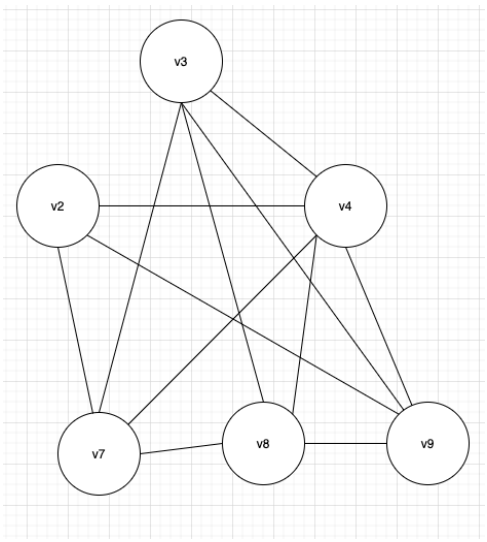
(b)

(i) 2-core



(ii)

3-core



(iii)