National University of Computer and Emerging Sciences, Lahore
Spring Semester 2008

Course: CS204 - Database Systems | Total Time Allowed: 3hrs.
Date: May 24, 2008 | Max Points: 50

Final Exam - Part I (MCQs)
(30 minutes Max. for this part)

Roll No: _____ Section: _____

Question 1: *(15 points)*
Please encircle the correct answer:

1. In the entity relationship model, the primary aspect of a composite attribute is that it

a) Consists of subparts, which represent more basic attributes
b) Is an attribute that has a set of values
c) Is an attribute that can be determined from other attribute values
d) Is an attribute whose values are distinct for each individual entity in the entity set
e) None of the above

2. When we map from an entity-relationship diagram to a set of relations, Which of the following is incorrect?

a) Each weak entity type becomes a relation
b) Key attributes of an entity type become the key of a relation
c) The key of a many-to-many relationship type is the combined key of all the participating relations
d) Each relationship type becomes a relation
e) None of the above

3. Specialization in the Enhanced Entity-Relationship model is

a) The process of defining a set of superclasses of an entity type
b) The process of defining a set of subclasses of an entity type
c) The process of defining an entity type that contains the common features of a set of entity types
d) The process of defining a set of weak entity types of an entity type
e) None of the above

4. If an attribute defined specialization is disjoint-total then which of the following statement is false.

a) The defining attribute is a multivalued attribute.
b) There exists a defining attribute in subclasses, which defines the type of the entity instances.
c) Defining attribute can have a null value.
d) The defining attribute must be a primary key of superclass.
e) All of the above

5. What is the minimum number of keys that any relation with n attributes must have?

a) 0
b) n
c) 1
d) 2^n
e) n/2

6. Which of the following update operations may cause a violation of the primary key constraint?

a) A deletion of one tuple from the relation

b) An insertion of one tuple into the relation

c) An update of one tuple in the relation

d) Both (b) and (c)

e) Both (a) and (b)

7. Given the relational schema consisting of Course(Cnumber, Cname, Dept) and Enroll(RollNo, Cnumber, Grade), which SQL query retrieves the courses for each department in which students are not enrolled?

a) SELECT Dept, Cname FROM Course
WHERE Cnumber NOT IN (SELECT Cnumber FROM Enroll) ORDER BY Dept;

b) SELECT Dept, Cname FROM Course
WHERE Cnumber IN (SELECT Cnumber FROM Enroll) ORDER BY Dept;

c) SELECT Dept, Cname FROM Course, Enroll
WHERE Course.Cnumber = Enroll.Cnumber ORDER BY Dept;

d) SELECT Dept, Cname FROM Course ORDER BY Dept;

e) All of the above

8. What is the result of the SQL query SELECT C, F FROM R, S WHERE B = D AND A = E;
given the following two tables, R and S?

R

A	B	C
41	21	32
42	22	32
43	24	32
43	21	31
45	21	31
41	20	31

S

D	E	F
20	41	4
22	42	5
23	43	6
24	43	6

a) A table with columns C and F whose 3 rows are (32,4), (32,5) and (32,6)

b) A table with columns C and F whose 3 rows are (32,5), (32,6) and (31,4)

c) A table with columns C and F whose 1 rows is (31,6)

d) A table with columns C and F whose 2 rows are (32,5) and (31,6)

e) None of the above

9. What constraint does the one functional dependency DeptNo → Dname define for the relation schema DeptSales(DeptNo, Dname, Month, Year, Sales)?

a) If two tuples have the same value for Dname then they have the same value for DeptNo

b) If two tuples have the same value for DeptNo then they have the same value for Dname

c) DeptNo must be a primary key for DeptSales

d) DeptNo must be a superkey for DeptSales

e) All of the above

10. Given the relation schema, DeptSales(DeptNo, Dname, Month, Year, Sales) and the set of functional dependencies, F = {DeptNo→Dname, {DeptNo,Month,Year}→Sales }, then which of the following functional dependencies is a valid inference?

a) {DeptNo,Month,Year}→Dname

b) {Month,Year}→Dname

c) DeptNo→Sales

d) Dname→Sales

e) None of the above

11. Two sets of functional dependencies, F_1 and F_2 are equivalent if

a) F_1 and F_2 contain no redundant functional dependencies

b) F_2 is a subset of F_1

c) F_1 and F_2 have the same number of functional dependencies

d) F_1 and F_2 have the different number of functional dependencies

e) None of the above

12. Given the relation DeptSales(DeptNo, Dname, Month, Year, Sales) with FDs
F = {DeptNo→Dname, {DeptNo,Month,Year}→Sales }, then DeptSales could suffer from

a) insertion anomalies

b) redundancy and inconsistency

c) deletion anomalies

d) updation anomalies

e) all of the above

13. Given the relation R(A,B,C,D) with FDs F = {AB→C, A→D} shown below.
What values could be inserted for the missing D and A column values. The domain for D is {d1,d2,d3,d4,d5,d6,d7} and the domain for A is {a1,a2,a3,a4}.

A	B	C	D
a1	b1	c1	d1
a1	b2	c2	
	b1	c1	d3
a4	b1	c4	d4

a) d1 and a1

b) d5 and a4

c) d5 and either a2 or a3

d) d1 and either a2 or a3

e) none of the above

14. Which of the following is not a desirable property of transactions?

a) Isolation

b) Atomic

c) Inconsistency

d) Permanency

e) None of the above

15. The write ahead log rule is that

a) A Log must be maintained for all occurring transactions

b) A log must be physically written to disk after the commit

c) A log must be physically written to disk before the commit processing can complete

d) A log must be written to log buffer before the commit processing can complete

e) None of the above

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	d	b	e	c	d	a	b	b	a	e	e	d	c	c

SECTION: _____ ROLL NUMBER: _____ NAME: _____

DATABASE SYSTEMS FINAL EXAM OBJECTIVE PART

[Fall 2012] [Total Points: 20] [Time: 30 min.]

Encircle the best option for each of the following:

1. Which of the following statements are true?

I. Each super key is a superset of some candidate key.
II. Each primary key is also a candidate key, but there may be candidate keys that are not primary keys.
III. The referential integrity constraint states that no primary key value can be NULL

a) I
b) II
c) I and II
d) II and III
e) I, II and III

2. Which of the following update operations may cause a violation of the key constraint?

a) A deletion of one tuple from the relation
b) An insertion of one tuple into the relation
c) An update of one tuple in the relation
d) Both (b) and (c)
e) Both (a) and (b)

3. Suppose relation R(A,B,C) has the following tuples. How many tuples appear in the result of

$$\pi_{A,B}(R) \bowtie_{R.B<S.B} (\rho_{S(A,B)}(\pi_{B,C}(R))) \text{ ?}$$

A	B	C
1	2	3
1	2	3
3	2	1

a) 2
b) 4
c) 6
d) 9
e) 3

4. Consider the following relation 'Grades' and the query given below:

Student	DB_grade	Algo_grade
A	45	NULL
B	NULL	90
C	100	80

SELECT student FROM Grades
WHERE (DB_grade>Algo_grade AND Algo_grade>75 AND DB_grade>90) OR (DB_grade<50)

Which students' tuples are returned?

a) A
b) B
c) B and C
d) A and C
e) A, B, and C

5. Consider the relation **Grade** given in the last question and the query given below:
SELECT COUNT(DB_grade) from Grades

What does the above query returns?

a) 145
b) NULL
c) 3
d) 2
e) None of the Above

6. Which of the following anomalies result from a transitive dependency?

a) Insertion
b) Deletion
c) Modification
d) All of the above
e) None of the above

7. A relation R(a,b) may have duplicate tuples. Which of the following queries has a result that is **guaranteed** not to have duplicates, regardless of what tuples R contains?

I) SELECT a FROM R WHERE a = 1
II) SELECT MAX(b) FROM R GROUP BY a
III) SELECT a, b FROM R GROUP BY a, b
IV) SELECT a FROM R WHERE a NOT IN (SELECT a FROM R)

a) III and IV
b) I and II
c) III only
d) I and III
e) I, II and III

8. Consider a relation R with attributes R(A, B, C, D, E). The following FDs hold on R: $AB \rightarrow C$, $BC \rightarrow AD$, and $D \rightarrow E$ hold. Which of the following is the key of R?

a) A
b) AB
c) ABD
d) ABC
e) BCD

9. Let R(A, B, C) satisfy the following FDs: AB → C, BC → A, and AC → B. The closure of A (i.e., A^+) is
   a) A
   b) AB
   c) AC
   d) BC
   e) ABC

10. Two sets of FDs, FD_1 and FD_2 are equivalent if
   a) FD_1 and FD_2 contain no redundant FDs
   b) FD_2 is a subset of FD_1
   c) FD_1 and FD_2 have the same number of FDs
   d) FD_1 and FD_2 have the different number of FDs
   e) FD_1 covers FD_2 and FD_2 covers FD_1

11. Given the relation SalesOrder(ONo, Oname, Date, Items) with FDs F = {ONo→Oname, {ONo, Date}→Items }, then SalesOrder could suffer from
   a) Insertion anomalies
   b) Redundancy and inconsistency
   c) Deletion anomalies
   d) Updation anomalies
   e) All of the above

12. Which of the following statements are correct?
   I. All relations in 3NF are also in BCNF.
   II. All relations with only two attributes are in BCNF.
   III. For any relation schema, there is a dependency-preserving decomposition into 3NF.
   a) I
   b) III
   c) II and III
   d) I and III
   e) I, II and III

13. For which of the following normal forms there is always a lossless-join decomposition for any relation schema?
   a) BCNF
   b) 3NF
   c) 4NF
   d) All of the above
   e) None of the above

14. Which of the following statements about ER models are correct?
   I. Many-to-many relationships cannot be represented in ER diagrams
   II. Relationship sets can have attributes of their own
   III. All many-to-one relationships are represented by a relationship between a weak and a non-weak entity set
   a) II
   b) III
   c) II and III.
   d) I and II
   e) I, II and III

15. Which of the following statements are true about weak entity sets:
   I. A weak entity set cannot have a primary key.
   II. A weak entity set must have a local attribute in primary key
   III. A weak entity must borrow an attribute from another entity set to form a primarykey.
   a) None of them
   b) I and II
   c) II and III
   d) III
   e) I, II and III

16. Suppose we have a relationship type, R that has a cardinality ratio of M: N, where the entity types involved are E1 with 2 instances and E2 with 3 instances. Also E1 and E2 have partial participation in R. What is the minimum and the maximum number of instances of the relationship type R?
   a) A min of 2 and a max of 3
   b) A min of 0 and a max of 6
   c) A min of 0 and a max of 3
   d) A min of 2 and a max of 6
   e) None of the above

17. Consider the following schedule of two transactions T1 and T2 on two data items X and Y.
   S: r1(x), r2(x), w1(X), r1(Y), w2(X), w(Y)

   The above schedule suffers from
   a) Lost Update
   b) Temporary Update
   c) Incorrect Summary
   d) All of the above
   e) None of the above

18. Which of the following is not true?
   a) The System log keeps track of all transaction operations that affect the values of database items
   b) The System log is kept on disk, so it is not affected by any type of failure except for disk failure.
   c) The effect of write operations of a transaction T can be undone or redone using the System
   d) The roll back of a transaction is needed if there is no commit entry [commit,T] in the log.
   e) None of the above

19. Consider the following schedule of three transactions T1, T2 and T3
   S: w1(X), r3(Y), w2(X), w3(Y), abort1
   a) Schedule S is strict
   b) Schedule S is cascadeless
   c) Schedule S is cascadeless and not strict
   d) Schedule S is strict and cascadeless
   e) None of the above

20. Two operations Op1 and Op2 in a schedule are said to be in conflict if
   a) Op1 and Op2 belong to different transactions
   b) Op1 and Op2 access the same item X
   c) At least one of the operations Op1 or Op2 is a write operation
   d) All of the above
   e) None of the above

SECTION: _____ ROLL NUMBER: _____ NAME: _____

DATABASE SYSTEMS FINAL EXAM SUBJECTIVE PART

[Fall 2012] [Total Points: 70] [Time: 150 min.]

NOTE: No calculators are permitted. Please write your solutions in the spaces provided on the exam. You may use the blank areas and backs of the exam pages for scratch work. Please do not use any additional scratch paper. Write your roll no in the upper right corner of every page.

Question 1 (5 points)

Consider a relation R(A, B, C, D, E, F, G, H, I, J), with FD's B → E, E → FH, BCD → G, CD → A, A → J, I → BCDE, H → I. The possible keys are {B}, {E}, {H}, {I}. Is this relation in BCNF? (use general definition of normal forms.) If your answer is yes, explain why. If your answer is no, decompose the relation into BCNF. State the reasons behind each decomposition and show your decomposition steps. Also specify final set of normalized relation schemas clearly.

Question 2 **(4+3+3= 10 points)**

Consider a relation R(A, B, C, D, E), with FD's AB → C, C → D, D → B, D → E.

a) Find the closures of D and AB.

b) Find all the keys for this relation. (you don't need to list superkeys that are not keys.)

c) Is this relation in BCNF? (use general definition of normal forms.) If your answer is yes, explain why. If your answer is no, decompose the relation into BCNF. Show your decomposition steps and also final set of normalized relation schemas.

Question 3 **(5 points)**

Consider the two sets of FDs: F = {A → B, A → C} and G = {A → B, B → C}. Check whether they are equivalent. Justify your answer.

Question 4 **(6+6+4+4= 20 points)**

Consider the following relational schema:

Users(<u>userid</u>, popularity, name) Sites(<u>siteid</u>, sitename, userid, viewcount) Entries(<u>entryid</u>, siteid, rating, message, createdtime, tag)

a) Write Relational Algebra and SQL statements to find all of the sitenames of Sites that have zero entries (no entries).

b) Write Relational Algebra and SQL statements to find all of the sitenames of Sites that have entries with a tag equal to "SQL Server" or NULL, but not any other tag values.

c) Write SQL statement to create the Entries table for the relational schema. Also specify PK constraint on entryid column, FK constraint on siteid column and CHECK constraint on rating column that ensures that rating is between 0 and 5 inclusively.

d) Define a view ActiveUsers that gives users with more than 5 sites. Your view must include the same attributes as the 'Users' table (userid, popularity, name).

Question 5 **(5 points)**

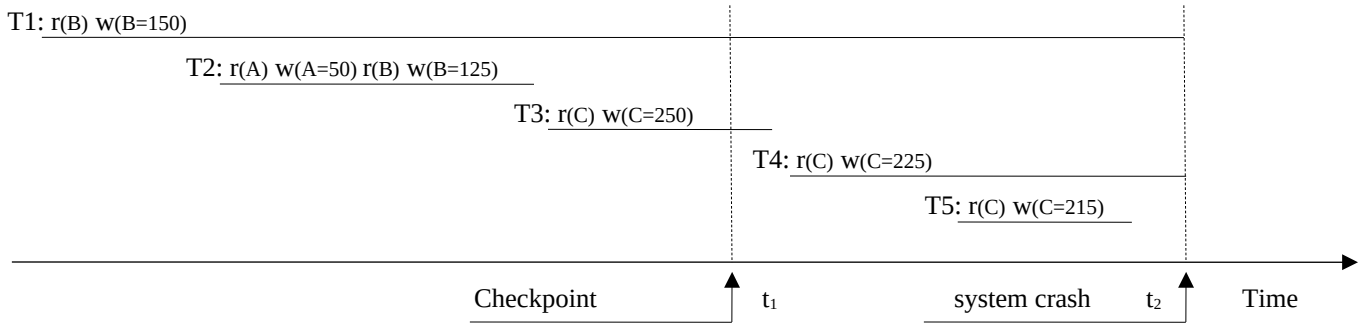
Consider the following schedule of four transactions T1, T2, T3, and T4.
S: r1(A); w1(A); r2(A); r2(B); w3(B); w2(C); r4(A); r4(B); r4(C); r2(D); r3(E).

Draw the serializability (precedence) graph for this schedule. State whether this schedule is (conflict) serializable or not. If the schedule is serializable, write down the equivalent serial schedule(s) otherwise explain why it is not.

Question 6 (5 points)

[FOR Section A & B Only]

Assume that the initial values of items are A=100, B=200, C=300. Given the following log of a recovery manager performing **deferred update**. Identify which (if any) transactions need undo and which transactions need redo operation(s)? Write down the values of items A, B, and C after system recovery.



[FOR Section C Only]

Determine whether the following schedule S is strict, cascadeless, recoverable, or nonrecoverable. Determine the strictest recoverability condition that the schedule satisfies and *also justify your answer*.

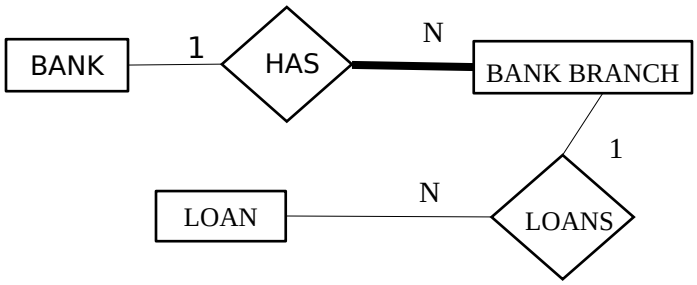
S: *r*1(A); *r*2(C); *r*3(*A*); *r*1(*C*); *r*2(*B*); *r*3(*B*); *w*1(*A*); *c*1; *w*2(*C*); *w*3(*B*); *w*2(*B*); *c*3; *c*2;

Question 7 **(3+4+3= 10 points)**

Consider the following ER models against each of the given statement. You job is to identify issues (if any) in each ER model and provide the correct ER model. *Do not worry about attributes. Do not use (min, max) notation to specify structural constraints.*

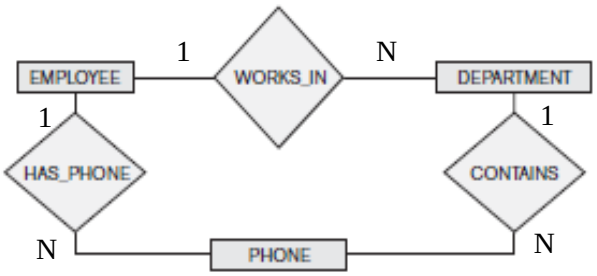
a) A bank has one or more branches. Each branch offers multiple Loans. A loan belongs to exactly one bank branch.

Insert correct diagram here:



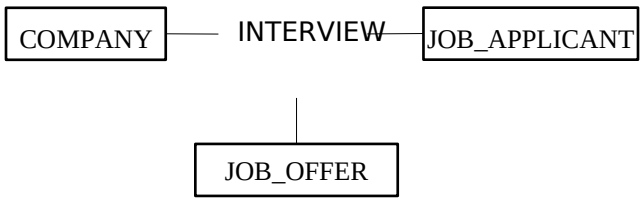
b) An employee can work in multiple departments (at least 2 and at most 4 departments). Each department must have one and may have up to three phone numbers. A phone number belongs to only one department. An employee can be reached at all the phone number of each department he works in.

Insert correct diagram here:



c) A company calls many applicants to fill some of its vacant seats (jobs). However, some interviews results in the job offer while others do not.

Insert correct diagram here:



Question 8 (10 points)

A local transportation authority in Lahore wants to implement a database to keep statistics on public transportation (buses), with emphasis on keeping track of delays and the number of travelers. Draw an ER diagram corresponding to incorporate the following information:

• Information on buses: This includes bus identification number, type, capacity, and production year. In addition to this the range of each bus (the number of kilometers it will drive on a full tank) should be recorded. The type of bus refers to the manufacturer's code for a specific kind of buses. All buses with the same code are identical.

• Information on bus drivers: You need to record each driver personal identification number, his hired date, the bus he words on and his salary. A bus driver does not drive a specific bus, but may drive any bus.

• Route information: The sequence of stops on each bus route. Each route has a unique route number.

• Vehicle usage: For each route and departure time, on each day, record which bus was used. (Note only a single bus is used for particular route and departure time –several buses can't be coupled together.)

• Timetable information: Information on planned arrival and departure times for each route and every stop.

• Timetable statistics: Information on actual arrival and departure times for every bus and every stop, on every day.

• Traveler statistics: Periodically, surveys are being made that record the destinations of all travelers in a given bus at a given time (between two stops).

• Manning: Who has worked on a particular vehicle at every time? It should be taken into account that manning may change at any time during a route.

Suppose that we desire the database to evolve over time (e.g. with new time tables), but we also want to be able to store and query historical data. Outline how your ER diagram could be changed to achieve this.

National University of Computer and Emerging Sciences, Lahore

Database Systems

Spring 2014

Total Time Allowed: *30 minutess* Max Points: *20*

Final Exam - Part 1

Section: _____ Name: _____ Roll No: _____

Question 1 *(20 points)*

ENCIRCLE THE BEST OPTION FOR EACH OF THE FOLLOWING:

Consider the relation S (*A, B,C*) with a set of fd's {A → C } for the next three questions.

1. What is the key of this S relation?
- **a.** A
- **b.** B
- **c.** C
- **d.** AB
- **e.** AC

2. What is the highest normal form of this S relation?
- **a.** 1NF
- **b.** 2NF
- **c.** 3NF
- **d.** BCNF
- **e.** DKNF

3. Which of the following decomposition of the S relation are in BCNF?
- **a.** S1(A, C), S2(B, C)
- **b.** S1(A, B), S2(B, C)
- **c.** S1(A, C), S2(A, B)
- **d.** S1(A, C), S2(B)
- **e.** S1(A, B, C), S2(A, C)

4. Which of the following is a minimal cover for the set of fd's *T* = {*AB→C, C→D, AB→D* }.
- **a.** {*AB→C, C→D, AB→D* }
- **b.** {*AB→C, C→D* }
- **c.** {*AB→D, C→D* }
- **d.** {*A→C, C→D* }
- **e.** {*B→C, C→D* }

5. Consider the relation R (*A, B, C, D, E*), with a set of fd's {AB → C, C → D, D → B, D → E }. What is the closure of $\{AC\}^+$.
- **a.** {*A, B, C, D* }
- **b.** {*A, C, D, E* }
- **c.** {*A, C, D* }
- **d.** {*A, B, D, E* }
- **e.** {*A, B, C, D, E* }

6. Which of the following guarantees that the spurious tuple generation problem does not occur with respect to the relation schemas crated after decomposition?
- **a.** natural join operation
- **b.** dependency preservation property
- **c.** lossless join property
- **d.** theta join operation
- **e.** None of the above

7. Purpose of normalization process is to minimize
- **a.** data redundancy
- **b.** insertion anomalies
- **c.** deletion anomalies
- **d.** update anomalies
- **e.** all of the above

8. Which of the following is the process of storing the join of higher normal form relations as a base relation, which is in a lower normal form?
- **a.** normalization
- **b.** denormalization
- **c.** BCNF
- **d.** top down
- **e.** none of the above

9. Which of the following update operations may cause a violation of the key constraint?
- a. A deletion of one tuple from the relation
- b. An insertion of one tuple into the relation
- c. An update of one tuple in the relation
- d. Both (b) and (c)
- e. Both (a) and (b)

10. Consider the following relation R and the query given below:

R

X	Y	Z
A	45	NULL
B	NULL	90
C	100	80

```
SELECT X
FROM R
WHERE (Y>Z AND Z>75 AND Y>90) OR (Y <50)
```

Which tuples are returned when we execute above query?

- a. A
- b. B

c. B and C
d. A and C
e. A, B, and C

11. Consider the relation R given in the last question and the query: SELECT COUNT(Y) from R

What does the above query returns?
a. 145
b. NULL
c. 3
d. 2
e. none of the above

12. A relation S(a,b) may have duplicate tuples. Which of the following queries has a result that is guaranteed not to have duplicates, regardless of what tuples S contains?

I) SELECT a FROM S WHERE a = 1
II) SELECT MAX(b) FROM S GROUP BY a
III) SELECT a, b FROM S GROUP BY a, b
IV) SELECT a FROM S WHERE a NOT IN (SELECT a FROM S)

a. III and IV
b. I and II
c. III only
d. I and III
e. I, II and III

13. Consider the schedule S of three transactions T1, T2 and T3.

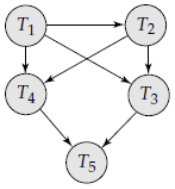
T1	T2	T3
read(A)		
read(B)		
write(A)		
commit		
	read(A)	
	write(A)	
		read(A)
	abort	
		commit

Which of the following is true?
a. schedule S is recoverable
b. schedule S is non-recoverable
c. schedule S is recoverable and cascadeless
d. schedule S is strict
e. none of the above

14. Schedule S suffers from which of the following problems?
a. lost update
b. phantoms
c. dirty read
d. all of the above
e. none of the above

15. How many serial schedules exist for the three transactions T1, T2 and T3.
a. 1
b. 3
c. 4
d. 6
e. 9

16. Consider the precedence graph G given below



Which of the following is true?

a. G is conflict serializable
b. G is not conflict serializable
c. G is not a valid precedence graph
d. Both b and c
e. None of the above

17. Transactions should possess several properties, often called the **ACID** properties. Which of the following are ACID properties?
a. Atomicity, Consistency, Independence, Durability
b. Atomicity, Consistency, Isolation, Durability
c. Atomicity, Control, Isolation, Durability
d. All of the above
e. None of the above

18. An entity set that does not have sufficient attributes to form a primary key is termed a _____
a. Strong entity set
b. Variant set
c. Weak entity set
d. Weak relationship set
e. none of the above

19. A pilot can fly three types of planes and a plane can be piloted by any qualified pilot. The pilot-plane type relationship is
a. N:3
b. 3:N
c. 1:3
d. 3:1
e. none of the above

20. Union subclass will contain
a. all attributes of the super classes
b. union of all attributes of the super classes
c. intersected attributes of the super classes
d. attributes of one class at a time

SECTION: _____ NAME: _____ ROLL NUMBER: _____

DATABASE SYSTEMS FINAL EXAM SUBJECTIVE PART

[Spring 2014] [Total Points: 80] [Time: 150 min.]

NOTE: No calculators are permitted. Please write your solutions in the spaces provided on the exam. You may use the blank areas and backs of the exam pages for scratch work. Please do not use any additional scratch paper. Write your roll no in the upper right corner of every page.

Question 1 **(5points)**

State whether each of the following implications is true or false. If it is false, give a relation withonly two tuples that satisfies the functional dependencies in the left-hand side of the implicationbut does not satisfy the dependencies in the right-hand side. If it is true, show which inferencerules you used to prove it is true.

a) $C \rightarrow A$ and $CA \rightarrow B \models C \rightarrow B$

b) $X \rightarrow Z$ and $Y \rightarrow Z \models X \rightarrow Y$

Question 2 **(5 points)**

Consider the relation R (*A, B, C*), with a set of fd's{A C, C A }. List all possible keys of this relation. Prove it.

Question 3 **(5 points)**

Consider the relation R (*A, B, C, D, E*), with a set of fd's{AB → C, C → D, D → B, D → E }. The possible keys are {A*B*}, {AC}, and {A*D*}.

a) Based on the given keys, Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.

b) Apply normalization until you cannot decompose the relations further. State the reasons behind each decomposition. Show each step of the decomposition process

Question 4 **(5 points)**

Find a minimal cover *F'*for the set of fd's*F* = {*AB*→*C*, *DEG*→*H*, *A*→*C*, *DE*→*G* }.

Question 5 **(20 points)**

Consider the following banking enterprise relational schema:

Branch (*branch-name*, *branch-city*, *assets*)
Customer (SSN, *customer-name*, *customer-city*)
Loan (*loan-number*, *branch-name*, *amount*)
Borrower (*SSN*, *loan-number*)
Account (*account-number*, *branch-name*, *balance*)
Depositor (*SSN*, *account-number*)

Write **Relational Algebra and SQL statements** for the following queries:

a) Find the names of all branches with customers who have an account in the bank and who live in Karachi.
b) Find all customers who have an account at *all* the branches located in Lahore.
c) Find the accounts that have more than one account holders (joint-accounts).
d) Find the names of all customers who do not have account in the branch named Faisal-Town.

Question 6 (5 points)

Create a view consisting of branch name and the names of customers who have either an account or a loan at that branch and name it *all-customer*.

Using the view *all-customer*, find all customers of the Garden-Town branch

Question 7 **(10 points)**

Consider the relational state of the banking enterprise scheme.

Branch

branch-name	*branch-city*	*assets*
Faisal Town	Lahore	1000000
Garden Town	Lahore	2000000
All-shah	Islamabad	5000000
Defense	Karachi	12000000

Customer

SSN	*customer-name*	*customer-city*
111	Ali Mustafa	Lahore
222	Nida Shaheed	Gujrat
333	Aliya Shah	Lahore
444	Ahmed Noor	Islamabad
555	FahadYahya	Karachi
666	Usman Shan	Karachi
777	Haider Ali	Lahore

Loan

loan-number	*branch-name*	*amount*
L-101	Faisal-Town	10000
L-102	Garden-Town	25000
L-103	Al-shah	50000
L-104	Al-shah	10000

Account

account-number	*branch-name*	*balance*
A-101	Faisal-Town	1000
A-102	Garden-Town	250

A-201	Al-shah	500
A-215	Defense	820
A-217	Faisal Town	9000
A-222	Garden Town	5470

Borrower

SSN	*loan-number*
111	L-101
555	L-102
333	L-104
111	L-103
222	L-101

Depositor

SSN	*account-number*
111	A-101
222	A-102
777	A-201
444	A-215
111	A-222
666	A-217
222	A-215
111	A-102

Given the above relational state, write the result of the following Queries. Also show the result of intermediate relations and describe in a sentence what each query does.

a) **select distinct** *customer-name*
from*borrower*
where*customer-name* **not in** (**select** *customer-name***from** *depositor*)

b)
select*branch-name*
from*account*
group by *branch-name*
havingavg(*balance*) >= **all** (**select avg**(*balance*)**from** *account***group by** *branch-name*)

Question 8 (15 points)

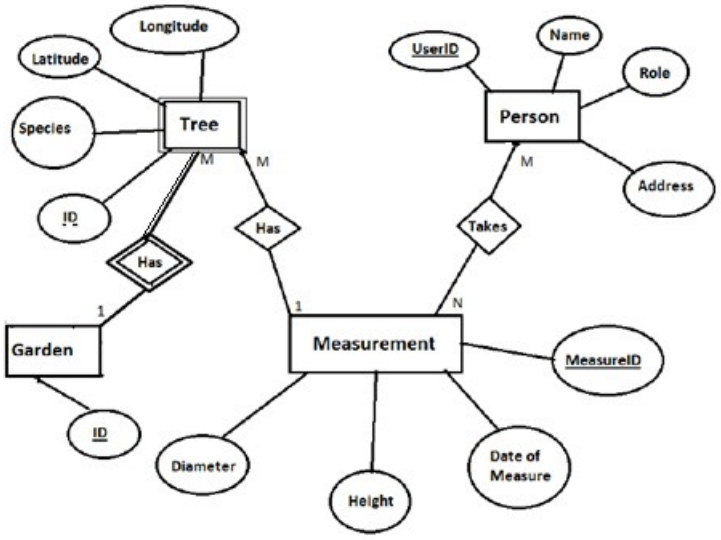
The company you work for wants to digitize their time cards. You have been asked to design the database for submitting and approving time cards. Draw the database ER diagram with the following information:

- A timecard should have hours worked and date submitted
- Each timecard is associated with exactly one employee. An employee can be permanent or employed on hourly basis.
- Each timecard should have a unique id
- Each timecard has a status: it is either approved, not approved, or pending
- Each employee has a unique id, name and address.
- Each employee submits a time card every pay period. i.e. In 1 year, they will submit multiple time cards
- Each employee either has direct deposit or physical check as their method of payment
- Each employee is associated with exactly one manager
- Each manager has a unique id and a name
- Each manager is in charge of multiple employees
- Each manager approves time cards for multiple employees

Make sure that you indicate all cardinality constraints and your model should not contain redundant entity sets, relationships, or attributes. If you need to make any assumptions, include them in your answer.

Question 9 **(5 points)**

Map conceptual schema given below to a set of relations. Choose the best mapping option and specify all the mapping steps. Also shows keys and all possible constraints



Question 10 (5 points)

Answer the following questions based on the ER Diagram in Question 9:

a) Could the "Date of Measure" attribute of the *Measurement* entity be the key for the entity, instead of the "MeasureID"? Why or Why Not?

b) We want to add a "Tools Used" attribute, which will store the tool(s) used to make measurements, but are not sure where this attribute belongs. We do know that one person might use multiple tools for different trees, and also that more than one tool may be used to measure the same tree (for example, different tools may be necessary to measure the same tree in the summer, than in the winter.) Where could we add this attribute? Choose *one or more* answers from the 3 entities and 2 relationships (we would add the attribute only once, but if you believe there are multiple possible places to add the attribute, we ask you to identify all potential candidates):

a. the entity Person
b. the relationship Has
c. the entity Measurement
d. the relationship Takes
e. the entity Tree

c) There are two roles that people can have, a Ranger and a Volunteer. Using what you know of subclassing, add these as two new entities in the ER Diagram. Add a reasonable attribute to each of the new entities. Just redraw the relevant part of the diagram that needs to change. Can we eliminate the **role** attribute from *Person*?

National University of Computer and Emerging Sciences, Lahore Campus

Course: Database Systems Course Code: CS203
Program: BS(Computer Science) Semester: Fall 2016
Duration: 180 min Total Marks: 70
Paper Date: 26-Dec-2016 Weight 50%
Section: All Page(s): 7

Exam: Final RegNo. (Section) ----------( ) Instruction/Notes: Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. No extra/rough sheets should be submitted with question paper.

Write your Roll no on every sheet.

You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Question 1: SQL and RA

Note: Your queries should not have hard coded values and should work for every instance of database.

Consider the following database of a Car showroom. (FK are self-explanatory)

Sales

ID	SalesPersonID	CarID	CustomerID	SalesDate
1009	10	A20	1	12/12/2016
1010	10	A30	2	1/12/2016
1011	12	H20	3	8/12/2016
1012	12	H20	4	8/11/2016
1013	13	H30	3	5/12/2016
1014	13	H30	4	10/10/2016
1015	13	H20	1	3/3/2016

* dates are in dd/mm/yyyy format

Employees

ID	Name	Type	Hiring Date
10	Hassan	SalesPerson	1/12/2003
11	Ayesha	Manager	1/9/2004
12	Kamal	SalesPerson	1/5/2004
13	Javaid	SalesPerson	5/5/2015

Cars

ID	Model	Make
A20	RDX	Acura
A30	MDX	Acura
H20	Civic	Honda
H30	Accord	Honda

Customers

ID	Name	ContactNo
1	Ali	51356468
2	Zarea	58975131
3	Fahad	56891646
4	Salman	89894646

Part a (10 points). At the start of each Month the Car Showroom selects a **Star Salesperson,** and displays his name on its website. The Star Salesperson is selected based on last month's performance, the Salesperson who made maximum sales in last month is selected as Start Employee. However, only the salespersons that have been working in showroom for the whole previous month qualify to be Star Employee.

You have to write a View (in SQL) the will give the name of Star Salesperson of Current Month. You view should be generic and work for every month, without a need to make any changes in query.

Who will be the star employee if current month was Jan 2017, according to your query?

```
select name from (
select top 1 E.ID,E.Name ,COUNT(S.ID) TotalSales
from Employees E inner join Sales S
on S.SalesPersonID=E.ID
where E.[Hiring Date]<= DATEADD(MM,-1,GETDATE())
and E.Type='SalesPerson'
and datepart(mm,SalesDate)= datepart(mm,DATEADD(MM,-1,GETDATE()))
and datepart(yy,SalesDate)= datepart(yy,DATEADD(MM,-1,GETDATE()))
group by E.ID, E.Name
order by 3 desc
      ) as A
```

(9 mark)

Note that student don't have to use these exact date functions, but they should at least write generic query, using getdate() or similar function.

Star employee of Jan 2017 Hassan (1 mark)

9 Marks for query. Marks are deducted according to the mistakes. -1 for each mistakes in query.

Part b (5 points). Write a query in RA that will give names of all the employees that have sold cars of make Acura Make but no Car of

make Honda. Write the Results of YOUR query as well.

R1 ← $(\pi_{ID,name}$ Employees) join $_{ID=SalespersonID}$ Sales join $_{CarID=ID}$ $(\sigma_{Make='Acura'}$ Car)

R2 ← $(\pi_{ID,name}$ Employees) join $_{ID=SalespersonID}$ Sales join $_{CarID=ID}$ $(\sigma_{Make=honda}$ Car)

Final Result ← π_{name} R1-R2 (4 mark)

Result: Hassan (1 mark)

Part c (5 points). Explain in one sentence what this query is doing, and write the result for given state of Database.

```
SELECT Name
FROM Employees E
WHERE NOT EXISTS ( ( SELECT ID
                     FROM Cars
                     WHERE Make='Honda')
                     EXCEPT ( SELECT CarID
                              FROM Sales
                              WHERE E.ID=Sales.SalesPersonID) );
```

Lists all the employees that have sold all the cars with make Acura. (3 mark)

Result: (2 mark if explanation is correct)

Name

Javaid

Question 2: Functional Dependencies and Normalization.

Part a (10 points). Given two sets of Functional Dependencies, F and G, on attributes {V, W, X, Y, Z}. Find if F and G are equivalent or not. Show all the steps.

F: {Z → YXW, XY → WZ, VW→ X} and G: {Z→YW, XY→ Z, W→ X, V→X}

F+ = {Z+ → XYWZ

XY+→ XYWZ

VW+→VWX

W+→W

V→V

X→X

Y→Y

}
(4 mark)

G+= {Z+→ YWXZ

XY+→ ZYWX

VW+→VWX

W+→WX

V+→VX, X+→ X, Y+→Y

} (4 mark)

G and F are not equivalent aas W→X and V→X does not hold in F (2 mark)

Part b (10 points). Find the candidate key of Relation R, when F_1 is the set of functional Dependencies that hold on R, and A, B, C, D, E are attributes of R. Also find the highest normal form, if it's not in BCNF then normalize till BCNF. Show all steps. F_1= {B→AC, DC→B, E→D, A→E}

Finding keys A+→ AED, B+→ ACEDB, C+→C, D+→ D, E+→ED, AC+→ACEDB, DC+→DCBAE, EC+→EDCBA so AC , DC, EC and B are the candidate keys, and let B be the primary key (5 mark with proper step)

Prime attributes A, B, C, D, E non-prime: none

1NF: it is in 1 NF as there is one key (1 mark)

2NF it is also in 2NF as there is no non-prime attribute partially dependent on partial key (1 mark)

3NF: It is also in 3NF as no non-prime attribute determines non-prime attribute (1 mark)

BCNF: E→D and A→E violate BCNF as A and E are not super keys.

There for the highest normal form of given R is 3NF (1 mark)

Converting to BCNF:
One possible decomposition is
R1: AED R2: BCD

B□A is not preserved

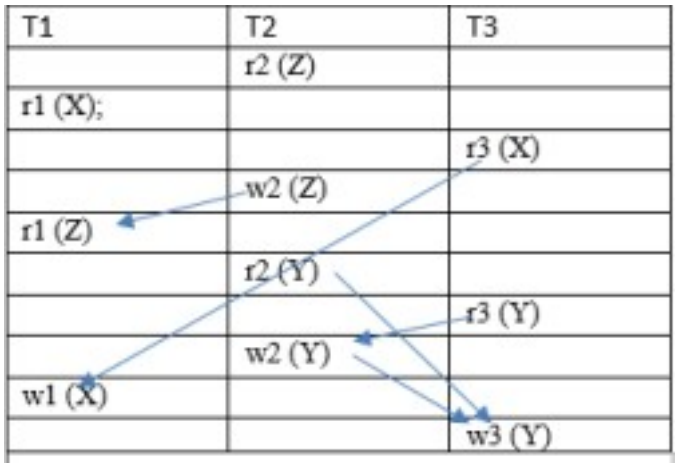
Another possible decomposition is
R1: ED R2: ABCD

Now A□E is not preserved. (BCNF 1 mark)

Roll No: Section: DBFall2016-Final Exam

Question3 (10 Points). S is schedule of four Transactions T1, T2, T3 and T4. Find if S is conflict serializable or not, using precedency graph. If yes show its equivalent serial schedule/s. Show all the steps.

S: r2 (Z); r1 (X); r3 (X); w2 (Z); r1 (Z); r2 (Y); r3 (Y); w2 (Y) w1 (X); c1; w3 (Y); c3; c2;

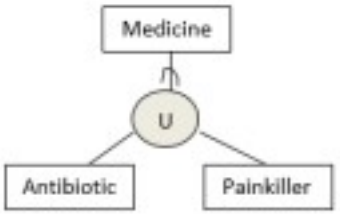


(10 mark if graph and explanation is correct, if explanation is incorrect then only 2 marks for graph, -1 if mistakes in graph.)

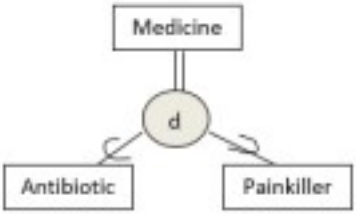
The schedule is not serializable as the is a cycle between t2 and t3

Question 4: ER, EER Diagram

Part a (2+3 points).
i). Are the following models, A and B, equivalent to each other? Give brief reason of your choice



Model A



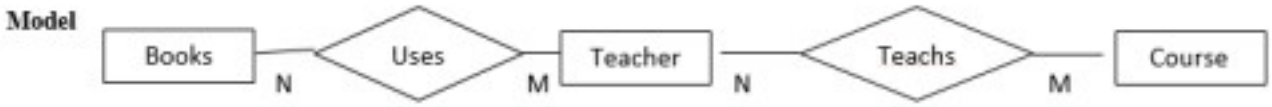
Model B

Not equivalent (1 mark). In Model B, Antibiotic U Painkiller = Medicine,

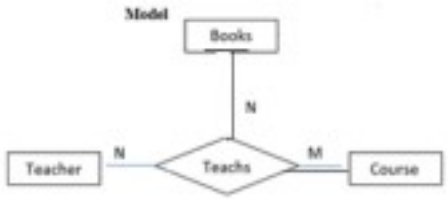
Where as in model A Medicine <subset> Antibiotic U Painkiller (1 mark)

ii). Consider the following ER models the given statement. You have to find if Model is correct or not according the functionality. If yes give reason if no give reason and correct model. For the model, assume that all the required attributes are present.

Statement: Each course is taught by one or more teachers and each teacher uses one or many books while teaching that specific course he is teaching.

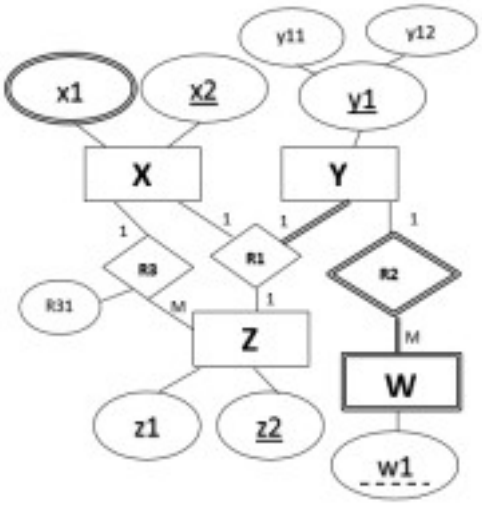


The relationship should be ternary and participation of books and course should be full



(1 mark for total participation and 2 for ternary relation)

Part b (5 points). Consider the following ER-EER diagram. Map it to Relational Schema, showing all the keys and foreign keys.



Simple entities

X: x2 (0.5 mark)

Y: y11, y12 (0.5 mark)

Z: z2, z1 (0.5 mark)

Weak entities

W: w1, y11 (FK refers Y.y11), y12 (FK refers Y.y12) (0.5 mark)

Multivalued entities

X1_X: x2 (FK refers X.x2), x1 (0.5 mark)

Relation ships

R1: x1 (FK refers X.x1), y1 (FK refers Y.y1), z1 (FK refers Z.z1) (0.5 mark)

Modifying Z for mapping R3 (0.5 mark)

Z: z2, z1, x2 (FK refers X.x2), R31 (0.5 mark)
FK and PK (1.5 mark)

Question 5 (10 points).

Create an EER diagram of the following case study:

A new mall, Emporium Mall, just had its grand opening few months ago in Lahore, Pakistan. This new mall is attracting a lot of customers and stores. Emporium Mall, which is part of a series of malls owned by a parent company, now needs a database to keep track of the management of the mall in terms of keeping track of all its stores as well as the owners and workers of the stores. Before we build a database for this system of malls, the first step will be to design an EER diagram for the mall owner. We gathered the following initial user specifications about the malls, with which we can start creating the EER diagram:
We need to record information about the mall and each store in the mall. We will need to record the mall's name and
Address. A mall, at any point in time, must contain one or more stores.
For each store, we will need to keep the following information: store number (which will be unique), the name of the store, the location of the store (room number), departments, the owner of the store, and manager of the store. Each store will have only one store manager. Each store is owned by only one owner. Each store is located in one and only one mall.
A store manager can manage only one store. We have to record information on the store manager: the name, social security number, which store he or she is working for, and salary. The store owner is a person. We have to record information about the store owner, such as name, social security number, address, and office phone number. A store owner has to own at least one store, and may own more than one store.
A store must have one or more departments. A department will not exist without a store. For each department we will store the department name, department number, and department manager. Each department has at least one employee working for it. For each employee in a store, we will have to keep an employee's name, social security number, and the department in which that the employee works. Employees must work in one and only one department.

Marks distribution:

Entities: 1 mark

Relations: 1 marks

Cardinality: 1 mark

Participation 1 mark

Keys: 1 mark

Specialization: 1 mark

Weak entity: 1 mark

-1 for adding unnecessary objects.

National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	Database Systems	Course Code:	CS203
Program:	BS(CS)	Semester:	Fall 2018
Duration:	3 Hours	Total Marks:	70
Paper Date:	Mon 24-Dec-2018	Weight	45%
Section:	ALL	Page(s):	8
Exam Type:	Final		

Student : Name:_____ Roll No._____ Section:_____

Instructions/Notes:
1. Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. No extra/rough sheets should be submitted with question paper.
2. You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Q1. *(5 points)* Consider the relation *R (A, B, C, D, E)*, with FDs *{A → BC, C → D, E → D, BE → A}*. List all the possible keys of *R*. Show the intermediate steps of your derivation. Also Identify the best normal form that R satisfies.

ANSWER: *Keys are {AE} and {BE}. Best normal form is 1NF.*

Q2. *(5 points)* Consider a relation with schema *R (A, B, C, D, E, G)*, with FDs *F = {D → G, C → A, CDB → E, A → B}*.
Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer. If R is not in BCNF, decompose it into a set of BCNF relations and show your steps. Indicate which dependencies if any are not preserved by the BCNF decomposition.

ANSWER:
Key is {CD} and Highest Normal Form is 1NF. It violates 2NF due to PFD1 & PFD2.
BCNF relation schemas are R1(C, D, E) with FD3, R2(D, G) with FD1, R3(C, A) with FD2, R4(A, B) with FD4; All FDs are preserved.

Q3. *(5 points)* Consider the following relation and compute the closure of $\{A\}^+$, $\{B\}^+$, $\{C\}^+$, $\{D\}^+$, and $\{CD\}^+$. Show your work.

R

A	B	C	D
1	2	3	4
4	2	3	4
5	3	3	4

ANSWER:
$A^+=\{ABCD\}$, $B^+=\{BCD\}$, $C^+=\{CD\}$, $D^+=\{CD\}$, and $CD^+=\{CD\}$.

Q4. *(5 points)* Consider the following two sets of FDs. Check whether or not they are equivalent. Provide proper reason.

F1 = {A→C, B→C, C→AB} and *F2 = {A→BC, B→A, C→A}.*

ANSWER: *They are equivalent.*

Q5. *(15 points)* Consider the following tables from an internet movie database. Primary keys are underlined and the column *fid* is a foreign key in the table *ratings*. The ratings are on the scale 1-5, where 5 is best and 1 is worst.

Films

fid	title	yrrelease
f1	Title1	2016
f2	Title2	2018
f3	Title3	2018
f4	Title4	2017
f5	Title5	2017
f6	Title6	2018

Ratings

viewerid	fid	rating
v10	f1	1
v30	f1	1
v50	f1	5
v20	f3	1
v30	f3	5
v50	f3	1
v60	f3	5
v10	f5	1
v90	f5	3
v50	f5	1
v70	f5	5
v80	f5	1

Write the result of the following queries for the database state given above.

a. SELECT films.title, COUNT(rating) AS worstRatings FROM films JOIN ratings ON films.fid = ratings.fid
WHERE yrrelease > 2016 AND rating=1 GROUP BY film.title HAVING COUNT(rating) >= 2
ORDER BY COUNT(rating);

b. Result ← $\sigma_{\text{viewerid= v90 OR viewerid=NULL}}$ (films ⋈ ratings)

c. Write SQL statement to **create** the ***Ratings* Table** given above. Also specify PK constraint on *(viewerid, fid)* columns, FK constraint on *fid* column and CHECK constraint on *rating* column that ensures that rating is between 1 and 5 inclusively.

ANSWER:

a)

title	worstCount
Title3	2
Title5	3

b)

fid	title	yrrelease	viewerid	fid	rating
f5	Title5	2017	v90	f5	3
f2	Title2	2018	null	null	null
f4	Title4	2017	null	null	null
f6	Title6	2018	null	null	null

c) self.

Q6. *(10 points)* For the above movie database, Specify the **SQL and RA statements** to answer the following questions:
a. Which are the newest films? *Do not hardcode SQL/RA statement. It must be generic.*
b. For each film, give the number of views and the percentage of best ratings received. *Sample output is as follows:*

fid	*TotalViews*	*%bestRatings*
f1	*3*	*33*
f3	*4*	*50*
f5	*5*	*20*

ANSWER:
a)
SQL:

```
SELECT *
FROM films
WHERE yrrelease = (SELECT   MAX(yrrelease)    FROM films);
```

RA:

R1 (newestYear) ← $\mathscr{F}_{MAX(yerelease)}$ (FILMS)

Result ← (FILMS $\bowtie_{yrrelease\ newestYear}$ R1)

b)
SQL:

```
SELECT T1.fid, T1.totalViews, T2.bestRatings/T1.totalViews*10  AS %bestRatings
FROM (SELECT fid, COUNT(*) AS totalViews   FROM ratings   GROUP BY fid) T1
JOIN (SELECT fid, COUNT(*) AS bestRatings   FROM ratings   WHERE rating=5   GROUP BY fid) T2
ON T1.fid = T2.fid
```

RA:

R1 (fid, totalViews) ← fid $\mathscr{F}_{COUNT(*)}$ (RATINGS)

R2 (fid, bestRatings) ← fid $\mathscr{F}_{COUNT(*)}$ ($\sigma_{rating=5}$ RATINGS)

R3 ← (R1 $\bowtie_{R1.fid = R2.fid}$ R2)

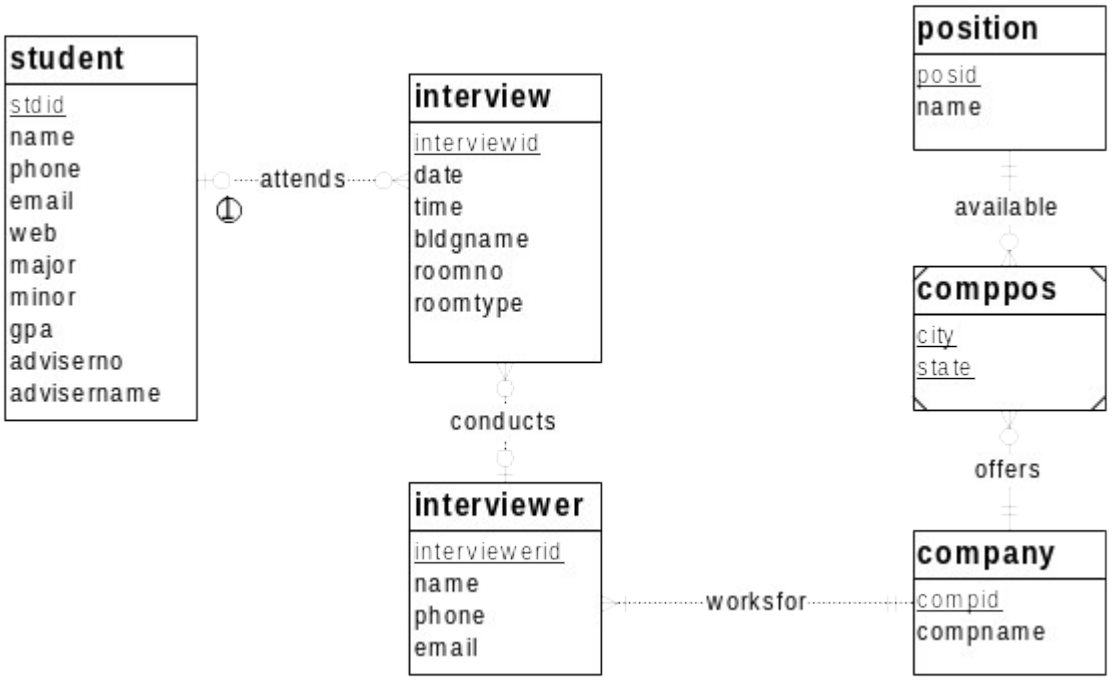
Result (fid, totalViews, %bestRatings) ← $\pi_{fid,\ totalViews,\ bestRatings/totalViews*100}$ (R3)

Q7. *(10 points)* Draw an ER diagram for the following case study. Your diagram should indicate the keys of all entities, as well as the cardinality and participation constraints of all relationships. Note any unspecified requirements, and make appropriate assumptions to make the specification complete but clearly state your assumptions along the diagram.

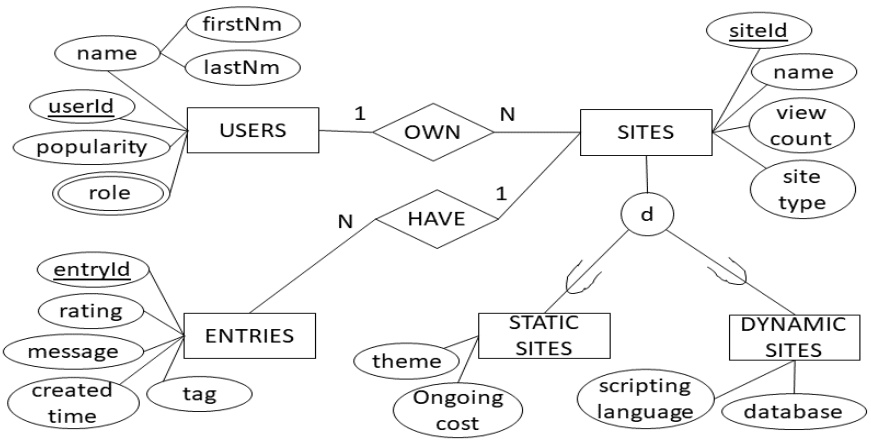
The database supports the placement office of a leading graduate school of computing. The primary purpose of the database is to schedule interviews and facilitate searches by students and companies. Consider the following requirements:

- Student data include a unique student identifier, a name, a phone number, an email address, a major, a minor, and a GPA.
- The placement office maintains a standard list of positions based on the Labor Department's list of occupations. Position data include a unique position identifier and a position description.
- Company data include a unique company identifier, a company name, and a list of positions and interviewers. Each company must map its positions into the position list maintained by the placement office. For each available position, the company lists the cities in which positions are available.
- Interviewer data include a unique interviewer identifier, a name, a phone, an email address, and a web address. Each interviewer works for one company.
- An interview includes a unique interview identifier, a date, a time, a location (building and room), an interviewer, and a student.

ANSWER:



Q8. *(5 points)* Map following EER diagram into a relational model.



ANSWER:

Users (userId, popularity, name) UsersRoles (*userId*, role) Sites (siteId, siteName, *userId*, viewCount, siteType)

StaticSites (*siteId*, theme, ongoingCost) DynamicSites (*siteId*, scriptingLanguage, database)

Entries (entryId, *siteId*, rating, message, createdTime, tag)

Q9. *(10 points)*

a. Discuss the ACID properties of a database transactions. What is the system log used for?

b. How does a category differ from a regular shared subclass? What is a category used for? Illustrate your answer with example.

ANSWER:

a) ACID properties of transactions are:

Atomicity: Transaction performed in its entirety or not at all

Consistency preservation: Takes database from one consistent state to another

Isolation: Not interfered with by other transactions

Durability or permanency: Changes must persist in the database

b) see textbook - EER chapter.

Roll No. _____Name _____ Section ___

National University of Computer and Emerging Sciences, Lahore Campus

	Course:	**Database Systems**	**Course Code:**	**CS203**
	Program:	**BS(Computer Science)**	**Semester:**	**Spring 2018**
	Duration:	**3 Hours**	**Total Marks:**	**65**
	Paper Date:	**Mon 21-May-2018**	**Weight**	**50%**
	Section:	**ALL**	**Page(s):**	**11**
	Exam:	**Final Exam**		

Instruction/Notes: Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. No extra/rough sheets should be submitted with question paper.

You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Q1. *(5 points)* Consider the following two sets of FDs. Check whether or not they are equivalent. Provide proper reason.

F1 = {A→B, B→C, C→A} and *F2 = {A→C, C→B, B→A}.*

Roll No. _____Name _____ Section ___

Q2. *(5 points)* Consider the relation schema *R(A, B, C, D, E, F)*, with FDs *F = {AB→CD, B→C, BC→D, CD→EF, E→F}*. Compute the minimal cover for *F* (i.e. F_c). Show your work!

Roll No. _____Name _____ Section ___

Q3. *(5 points)* Consider the relation *R(A, B. C, D, E)*, with FDs *{AB →C, DE →C, B →D}*. Possible key of this relation is *{ABE}*. State which of the following decompositions of R relation are lossless decomposition. Justify your answer.

a. *R1(A, B, C), R2(C, D, E)*, and *R3(B, D)*.

b. *R1(A, B, C), R2(A, B, E)*, and *R3(B, D)*.

Roll No. _____Name _____ Section ___

Q4. *(5 points)* Consider the relation schema *R(A, B, C, D)*, with FDs *{AB → C, BC → D, CD → A}*. Identify the best normal form that *R* satisfies (*1NF, 2NF, 3NF, or BCNF*). Justify your answer. If *R* is not in *BCNF*, decompose it into a set of BCNF relations. Indicate which dependencies if any are not preserved by the decomposition.

Roll No. _____Name _____ Section ___

Q5. *(5 points)* Consider the following classes of schedules: conflict-serializable, view-serializable, strict, cascadeless, recoverable and non-recoverable. For a schedule *S: r2(X); w3(X); w1(Y); r2(Y); r2(Z); r2(Y); c3; c2; r1(Z); c1*, state which of the preceding classes it belongs to. Give proper reason. The actions are listed in the order they are scheduled. Also draw the serializability (precedence) graph for this schedule. If the schedule is conflict-serializable or view-serializable, write down the equivalent serial schedule(s) otherwise explain why it is not.

Roll No. _____Name _____ Section ___

Q6. *(10 points)* Consider the following database of the "BLOGs" website. The website keeps tracks of the different users and blog written by them on different topics. Each user is identified by a unique username. The website also keeps track of the various comments given by Users on the Blogs.

The field Bwriter in Blog table is a foreign Key from user table and it gives the unique username of the Blog-writer and similarly the field Cwriter in Comment Table is a foreign key and gives the username of the user who have given a comment on the Blog.

USER

Uname	Age	Gender
Sara	25	F
Zara	42	F
Ali	15	M
Ahmad	19	M
Aliya	27	F
Tania	29	F
Hamza	34	M

TOPIC

TId	Name	Subject
1	Deep Learning	Computer Science
2	Big Data	Computer Science
3	Databases	Computer Science
4	Algorithms	Computer Science
5	Human Interactions	Philosophy

BLOG

BId	Bname	Bwriter	TopicId
10	BigData Frameworks	Ahmad	2
20	Generation Gap	Sara	5
100	Map Reduce	Hamza	2
30	The world of CNN	Ali	1
50	Cassandra	Ali	3
70	Neural Nets	Tania	1
60	MongoDB	Tania	3
120	Emerging trends	Sara	2
80	Hbase	Ali	3

COMMENT

CId	BlogId	Cwriter
1	20	Hamza
2	100	Hamza
3	20	Zara
20	80	Hamza
7	30	Zara
9	50	Zara
5	80	Ali
12	50	Ahmad
15	50	Tania

Write both **SQL and Relation Algebra Queries** for the following tasks

a. Find the name and age of the users who have never written any blog and have never given any comment.

b. Find the name of the users who have given comment on all the blogs written in Computer Science area.

```
Select Uname, Age
From User
Except
Select Uname, Age
From User join Blog on Uname=Bwriter

INTERSECT

Select Uname, Age
From User
Except
Select Uname, Age
From User join Comment on Uname=Cwriter
```

Find the name of the users who have given comment on all the blogs written in Computer Science area.

```
Select Uname
From User U
Where Not Exists
        (Select BId
             From Topic join Blog on TID = TopicId
             Where Subject = “Computer Science”
            EXCEPT

             Select BId
             From (Topic join Blog on TID = TopicId) join Comment on Bid = BlogId
             Where U.Uname = Cwriter

)
```

Roll No. _____Name _____ Section ___

Q7. *(5 points)* For the above database, create a view that find and list the pair of users who have never written a blog on the same Topic. If this query is run on the above database, the result should be:

Blog Writer 1	Blog Writer 2
Ahmad	Tania
Hamza	Ali
Hamza	Tania

Create View **UserPairs** (BlogWriter 1, BlogWriter2) AS

```
Select U1.Uname, U2.Uname

From User U1 join User U2 on U1.Uname != U2.Uname

Where Not Exist (

        (Select TId from BLOG where Bwriter=U1.Uname)

        Intersect

        (Select TId from BLOG where Bwriter=U2.UID)

)
```

Roll No. _____Name _____ Section ___

Q8. *(10 points)* Write the result of the following queries for the Database State given above. Also show the intermediate tables. Explain in one sentence what these queries are doing.

a. STopics ← $\Pi_{Subjects}$(TOPIC)
BSubjects ← $\Pi_{Bwriter, Subjects}$(TOPIC $\bowtie_{TId=TopicId}$ BLOG)
T ← $\Pi_{Bwriter}$ (BSubjects) – ($\Pi_{Bwriter}$ (($\Pi_{Bwriter}$(BSubjects) x STopics) – BSubjects))

b.
```
SELECT  BId
FROM  blog B  JOIN  user U  ON  Bwriter=Uname
WHERE  U.age < 30
AND  B.BId  IN  ( SELECT BlogId  FROM comment  GROUP BY BlogId  HAVING  COUNT (*) >= 2 )
AND  NOT EXISTS (SELECT *  FROM comment  WHERE B.Bwriter = Cwriter AND B.Bid = BlogId )
```

STopics

Subject
Computer Science (CS)
Philosophy (P)

BSubjects

Bwriter	Subject
Ahmad	CS
Sara	P
Hamza	CS
Ali	CS
Tania	Cs
Sara	CS

T

Bwriter
Sara

This query gives the Blog writers who have written a blog on all the subjects

B part query

This query finds the blogs such that the blog writer age is less than 30, and number of comments on the blog are two or more and none of the comment is from the blog writer

T

Bid
20
50

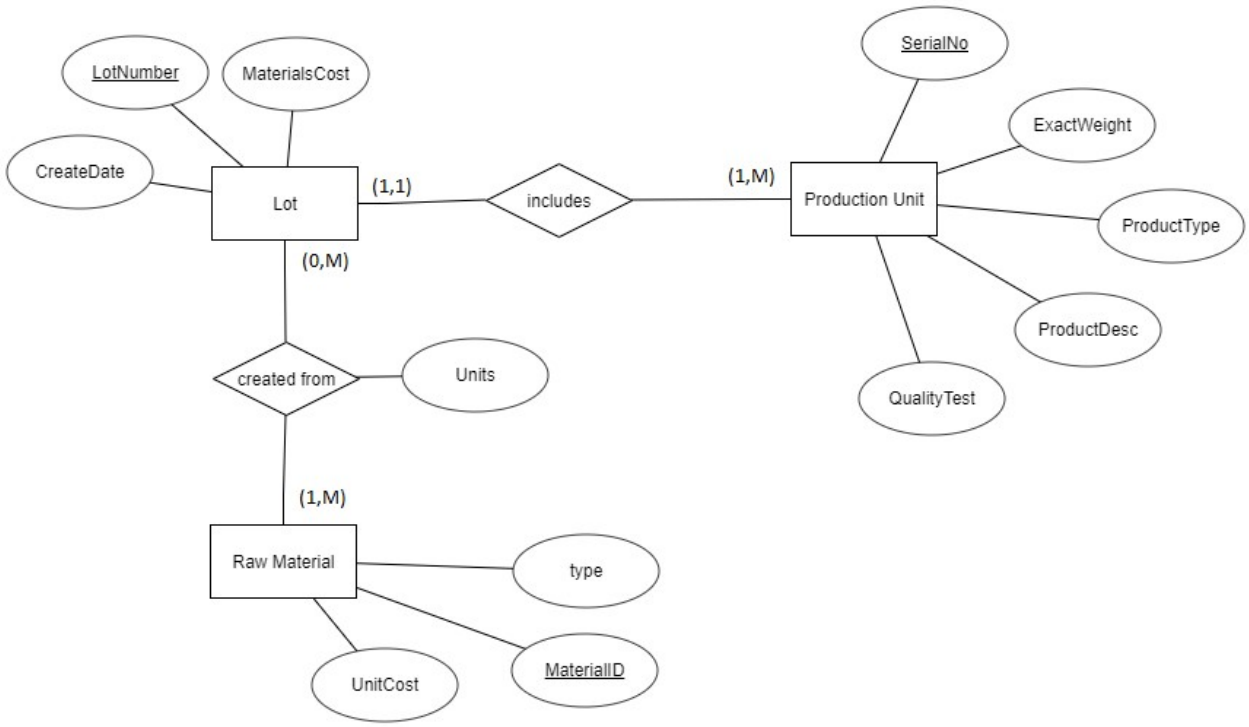
Q9. *(10 points)* Draw an ER/EER diagram for the following case study. Specify key attributes of each entity type and structural constraints on each relationship type. Note any unspecified requirements, and make appropriate assumptions to make the specification complete but clearly state your assumptions along the diagram.

A taxi company (like Uber) needs to model their activities. There are two types of employees in the company: drivers and operators. For drivers it is interesting to know the date of issue and type of the driving license, and the date of issue of the taxi driver's certificate. For all employees it is interesting to know their personal number, address and the available phone numbers. The company owns a number of cars. For each car there is a need to know its type, year of manufacturing, maximum number of passengers in the car and date of the last service. The company wants to have a record of

car trips. A taxi may be picked on a street or ordered through an operator who assigns the order to a certain driver and a car. Departure and destination addresses together with times should also be recorded.

Roll No. _____Name _____ Section ___

Q10. *(5 points)* Map following ER diagram into a relational model.



Roll No. _____ Name _____ Section ____

National University of Computer and Emerging Sciences, Lahore Campus

Course:	**Database Systems**	**Course Code:**	**CS219/CS203**
Program:	**BS (Computer Science)**	**Semester:**	**Spring 2020**
Duration:	**3 Hours**	**Total Marks:**	**50**
Paper Date:	**Mon 29-Jun-2020**	**Weight**	**50%**
Section:	**BCS-4A, BCS-4B, BCS-6A**	**Page(s):**	**2**
Exam:	**Final Exam**	**Questions:**	**6**

NOTES:

HOW TO SUBMIT ANSWER SHEET/SOLUTION *(DON'T SEND INDIVIDUAL/SEGMENTS OF SOLUTIONS and MULTIPLE COPIES)*:

1. Prepare a single *PDF file* (merge individual answer sheets into a single pdf file *in order* and with *correct numbering*).
2. Mention your *Full Name*, *Roll Number,* and *Section* clearly on each document; *any anonymous document will not be marked at all*.
3. You will be given **an extra 30 minutes** to complete this submission process in two mediums (i) Through **Slate or Google Classroom, or both** (ii) Using following **email** address: ishaq.raza@nu.edu.pk; add your file name to email subject line.

   IMPORTANT:
   Your **file name** should contain *Course Abbreviation Name* (DB), your *Section* (BCS-4A), and *Roll No*, (**For example: *DB_BCS-4A_18L-1234.pdf***).
4. *Late solutions received will NOT be considered.*

You will not get full credit if you do not show proper working, reasoning and steps as asked in question statements.

The current pandemic has unprecedented effects on the people and governments. The government of Pakistan wants the researchers to team up and develop systems that can detect disease outbreak and other medical conditions. It has invited the researchers to submit research proposals for funding. Your task is to develop a database for storing all the proposal and related details like researchers that will participate in it and the resources that are requested.

Proposal (ID, name, duration, teamID)
Team (teamID, teamName)
Researcher (resrID, name, email, DOB, position, university)
ResearchersInTeam (teamID, resrID, resrRole, remuneration)
Resource (ID, name, price, description)
ProposalResources (proposalID, resourceID, quantity)

The proposal duration is given in years.
The attribute Position in researcher table can be Professor, Assistant Professor, Lecturer, Instructor, Student etc.
The attribute resrRole indicates the role of the researcher which can be PI (Principle investigator), COPI (co - principle investigator) or team member. Attribute remuneration indicates the amount of money that will be given to each researcher.

Roll No. _____ Name _____ Section ____

Q1. *(16 points)*
Write query in <u>Relational algebra (RA) and SQL</u> to solve the following:

a. Print the ID and name of the teams in which every researcher is under the age of 40.
b. Find the pair of teams that have exactly same members. Print the IDs of such teams.
c. Print the name and id of the proposal that demands maximum funds. The funds required by the proposal includes the remuneration of all the researchers working on it and the price of all the resources required.
d. List the names of the team that have PI as well as COPI.

Q2. (4 points)
It is required that a team do not submit more than two proposals. Write a SQL query or trigger or view to solve this issue?

Q3. *(1+1+2+2+4= 10 points)*
Consider a relation schema *R (A, B, C, D, E)*, with FDs *F = {C→AB, A→E, D→E, BD→C, CD→B}*.
Show all steps, working, and reasoning to answer the following questions.

a. Determine all possible keys. Prove it.
b. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.
c. Decompose the relation R into a 2NF schema, if it is not in 2NF. *(<u>Remove 2NF violations only, in this part</u>)*
d. Check whether your answer to part **(c)** is in 3NF. If not, decompose it into a 3NF schema. List clearly complete set of 3NF schema relations with all keys and FDs.
e. Check whether your answer to part **(d)** is in BCNF. If not, decompose it into a BCNF schema. List clearly complete set of BCNF schema relations with all keys and FDs and also indicate which dependencies if any are not preserved.

Q4. *(10 points)*
Identify the data requirements of FAST Computer Lab Management system. The FAST consists of various computer labs for conducting lab sessions, research, fyp, and have general purpose labs too. Make sure that it has **at least** 5 regular entity types, 4 relationship types, a weak entity type, an n-ary (n>2) relationship type, and a specialization.
Design and Draw an EER diagram (using notation discussed in lectures) for a database of a FAST Computer Lab Management system. Specify all constraints that should hold on the database.

Q5. *(5 points)*
Consider the EER diagram in Question 4. Map the EER schema into a relational schema. Specify all constraints that should hold on the database. Justify your choice of mapping options, if any. State any assumptions you make.

Q6. *(5 points)*
Consider the relational schema designed in Question 5. Identify five functional dependencies that should hold in the system.

National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	Database Systems	Course Code:	CS2005
Degree Program:	BS (CS, DS, SE)	Semester:	Spring 2023
Exam Duration:	3 Hours	Total Marks:	75
Paper Date:	Thu 25-May-2023	Weight	50%
Section:	ALL	Page(s):	12
Exam Type:	Final Exam	Total Questions:	9

Instruction/Notes: Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. ***No extra/rough sheets should be submitted with question paper***.
You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

CLO No.	3		6							
Q. No.	1	2	3	4	5	6	7	8	9	Total
Marks										

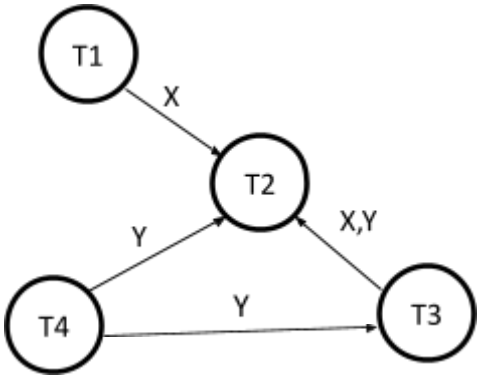
Roll No: _____ **Section:** _____ **Name:** _____

Q1. *(5 points)* Consider the following schedule of four transactions T1, T2, T3, and T4.

S: r1(X), r2(X), r3(X), w4(Y), w2(X), r3(Y), w2(Y).

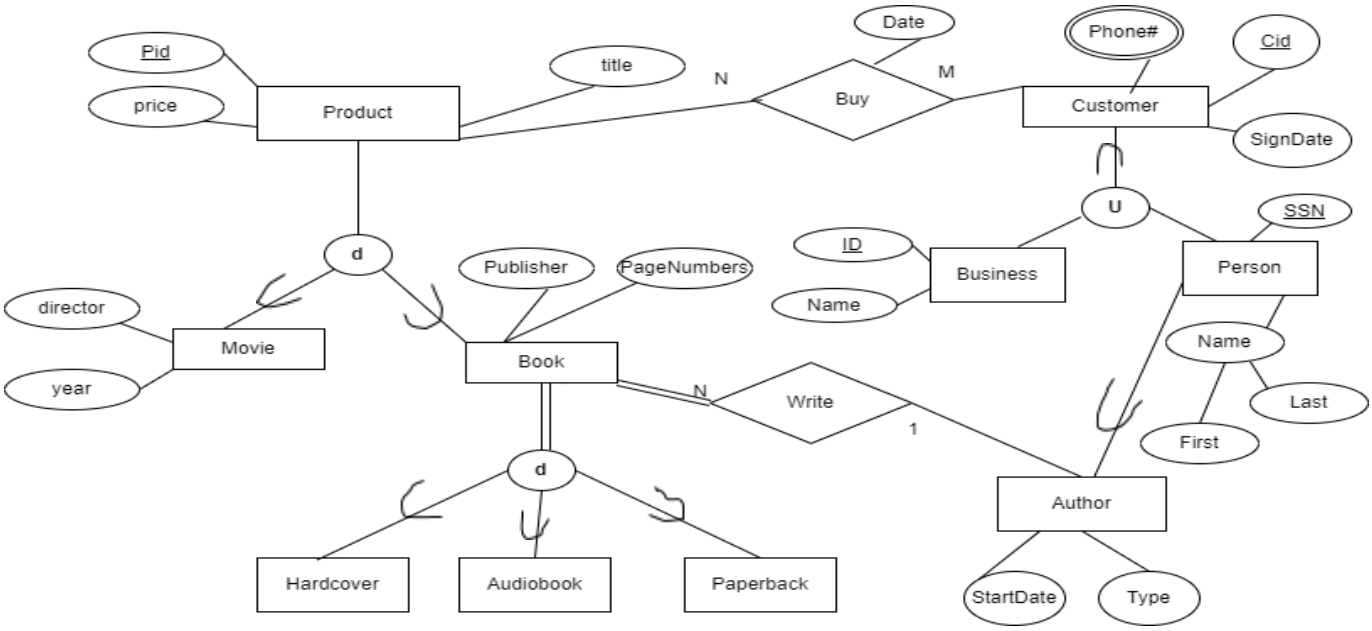
Draw the serializability (precedence) graph for this schedule. State whether this schedule is (conflict) serializable or not. If the schedule is serializable, write down the equivalent serial schedule(s) otherwise explain why it is not.

Ans:
S: r1(X), r2(X), r3(X), w4(Y), w2(X), r3(Y), w2(Y).
It is conflict-serializable and equivalent serial schedules are 1) T1□T4□T3□T2; 2) T4□T1□T3□T2; 3) T4□T3□T1□T2.



Roll No. _____

Q2. *(10 points)* Map the following ER/EER Diagram into a relational model and specify all the constraints including primary key, foreign key, not null, and unique.



Roll No. _____

Consider the following SOFTEC database for the next two questions:

SOFTEC holds Software Competitions each year where Teams of students from various universities participate and present their projects. Some expert University Professors from around Pakistan are invited as judges. Judges evaluate **at max** five projects and give points to each Project on a scale of 1-10. Each Project is evaluated by exactly three judges, and the Project with the maximum points wins the competition. SOFTEC also gives cash prizes to the runner-up and third team.

JUDGE

judgeID	name	university
1	Tahreem	FAST
2	Izaan	NUST
3	Isbah	LUMS
4	Ismail	LUMS
5	Alia	NUST

TEAM

teamID	*name*	university	city
1	Hero	FAST	Lhr
2	Xero	LUMS	Lhr
3	Evilx	FAST	Isl
4	Fame	NUST	Isl
5	Daark	UMT	lhr

PROJECT

projectID	Title	teamID
1	StarMiner	1
2	Chatgpt++	4
3	NextLevel	1
4	IOTmaster	2
5	RoboX	3
6	Webzz	5

ASSIGNED

judgeID	*projectID*	point
1	2	5
1	3	6
2	4	5
3	4	7
3	5	4
4	2	3

Q3. *(10 points)* Consider the database state given above and for each of the following queries, **(i)** Give the output for the database state given above and **(ii)** Explain in one simple English sentence what these queries are trying to do (achieve).

a. $R(PID, JID) \leftarrow \pi_{projectID,\ judgeID}$ Assigned

$S(PID) \leftarrow \pi_{projectID} (\sigma_{city = 'Isl'} (Project * Team))$

$Temp \leftarrow \pi_{JID}(S \times (\pi_{JID}(R)) - R)$

$Result \leftarrow \pi_{JID}(R) - Temp$

b.
```
SELECT  J.judgeID, J.name
FROM        Judge J
WHERE EXISTS  (SELECT * FROM  Assigned A
                    WHERE A.judgeID = J.judgeID AND
                    J.university IN (SELECT university from  Project P join Team T
                                on P. teamID = T. teamID and T.university = J.university)
                    );
```

Ans:

a) Find the judges who have evaluated all the project from universities in Islamabad

Result

JID
Null

b) Find the judges who are assigned projects from the university they are associated with.

judgeID	name
1	Tahreem
2	Izaan
3	Isbah
4	Ismail

Q4. *(15 points)* Consider the above SOFTEC database for the following problems.

a. Write SQL and RA statement to list the name and ID of the Judges who have evaluated more than three projects and have given each project less than 5 points.

b. Write SQL and RA statement to list the name of the Judges who are from the same university as "Dr. Ali Pasha" and are assigned all the projects that are assigned to "Dr. Ali Pasha".

c. Create a View that lists the Project ID, Title, TeamID and the number of Judges currently assigned to that project.

Roll No. _____

Q5. *(5 points)* Consider two sets of FDs, F and G, $F = \{A \rightarrow B, C \rightarrow D, AB \rightarrow C, AB \rightarrow D, E \rightarrow F\}$ and $G = \{A \rightarrow BC, C \rightarrow D, E \rightarrow F, ABC \rightarrow D\}$. Are F and G equivalent? Prove it.

Ans: Both sets are equivalent.

Q6. *(5 points)* Find a minimal cover of *F = {A → B, C → D, E → F, AB → D, AB → C}*. Show all steps.

Ans: ***Fc = {A → B, C → D, E → F, ~~AB → D~~ , AB → C}*** *or* ***Fc = {A → BC, C → D, E → F}.***

Roll No. _____

Q7. *(4 points)* Consider the relation R (A, B, C, D, E), with FDs *F= {A → CD, B → CE, E → B}*. State which of the following decompositions of R relation are lossless decomposition. Prove it.

a. *R1(A, E), R2(B, E), R3(A, C, D)*
b. *R1(A, B), R2(B, C, E), R3(A, C, D)*

Ans: Keys of R are AB & AE.
a) Lossless decomposition. ***R1(A, E), R2(B, E), R3(A, C, D)*** **(R1∩R2)→R2 & (R1∩R3)→R3**
b) Lossless decomposition. ***R1(A, B), R2(B, C, E), R3(A, C, D)*** **(R1∩R2)→R2 & (R1∩R3)→R3**

Roll No. _____

Q8. *(6 points)* Consider the relation schema R (A, B, C, D, E, F), with FDs *F= {A → BC, B → D, CF → E, E → F}*. Suppose *{AE}* and *{AF}* are the two possible keys of this relation. Show all steps, working, and reasoning to answer the following questions.

a. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.

Clearly show the complete set of schema relations for each of the following parts with all keys and FDs and also indicate which dependencies if any are lost.

b. Decompose the relation R into a 2NF schema if it is not in 2NF. *(Remove 2NF violations only, in this part)*

c. Check whether your answer to part **(b)** is in 3NF. If not, decompose it into a 3NF schema. *(Remove 3NF violations only)*

d. Check whether your answer to part **(c)** is in BCNF. If not, decompose it into a BCNF schema.

Ans:

a) HNF=1NF as FD1: A → BC violate 2NF;

b) 2NF Schema is R1(A E F) with FD4: E→F and keys are AE & AF
R2(A B C D) with FD1: A→BC & FD2: B→D
FD3: CF→E is lost

c) 3NF Schema is R1(A E F) with FD4: E→F and keys are AE & AF
R21(A B C)
R22(B D)

d) BCNF Schema is R11(A E)
R12(E F)
R21(A B C)
R22(B D)

Q9. *(15 points)* Draw an ER/EER diagram (using notation discussed in lectures) for the above scenario. Specify all constraints that should hold on to the database and state any assumptions you make.

In the Medical System, **patients** receive medical care from doctors in a healthcare facility. Each patient is assigned a unique ID and has attributes such as name, address, and phone number. **Doctors** providing medical care also have unique IDs and possess attributes, including their name, specialization, address, and phone number. Patients can schedule appointments to see doctors for medical consultations. Each **appointment** has a unique ID, date, time, and reason for the visit. A patient can have multiple appointments scheduled with the same doctor on different dates. During the medical consultation, doctors may prescribe medications to patients. A **prescription** is identified by a unique ID and contains information such as the date and dosage instructions. A doctor can issue multiple prescriptions for different patients. Medical records are maintained for patients, capturing their medical history and treatments received. A medical record is represented by a unique ID and includes the patient ID, doctor ID, date of the record, diagnosis, and treatment details. Each patient can have multiple medical records associated with different doctors. Patients can undergo various tests to aid in diagnosis. The medical tests are recommended by doctors and have a unique ID, date, and results. In certain cases, doctors may refer patients to other specialized doctors for further evaluation or treatment. We keep track of the date of referral and the reason for the referral. A doctor can make multiple referrals for different patients.

National University of Computer and Emerging Sciences

Lahore Campus

Database Systems (CS2005)

Date: Thu, 23 May 2024

Course Instructor(s)

ZA, MN, SF, AA, HI, MM, IR

Roll No _____ Section _____ Student Signature _____

Final Exam

Total Time (Hrs.): 3

Total Marks: 70

Total Questions: 9

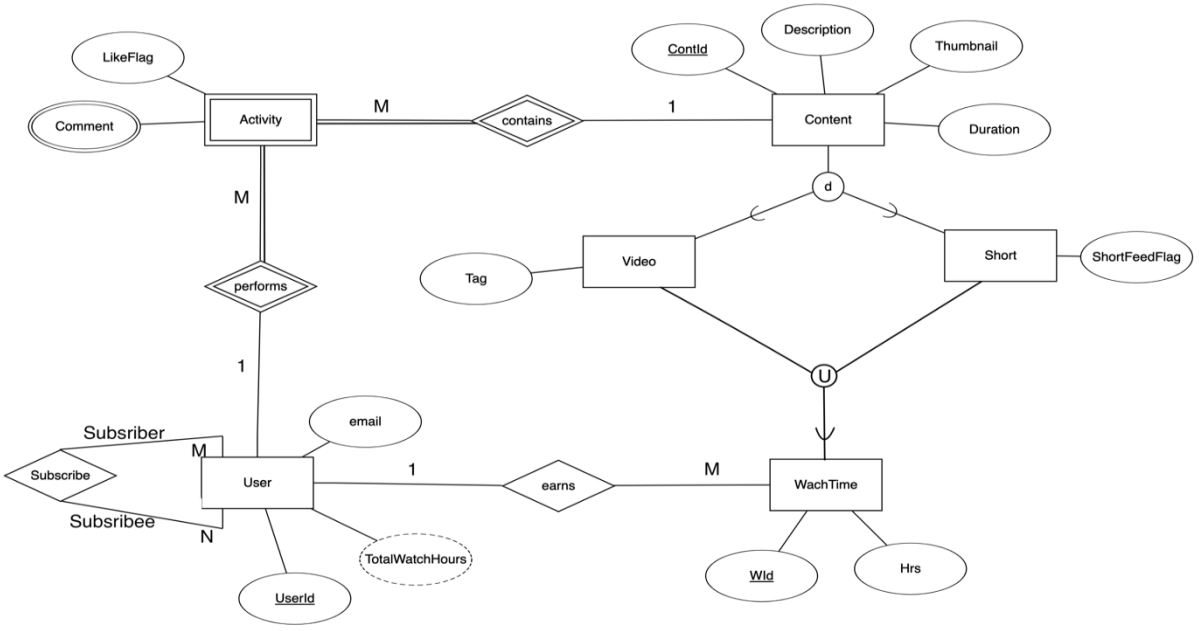
Do not write below this line.

Note: Please ensure that you attempt all questions and their respective parts in the given order.

SOLUTION

CLO # 2: Design conceptual, logical and physical database schemas using different data models.

Q. No 1: Map the following ER/EER Diagram into a relational model and specify all the constraints including primary key, foreign key, not null, and unique. [10]



CLO # 2: Design conceptual, logical and physical database schemas using different data models.

Q. No 2: Draw an ER/EER diagram (using notation discussed in lectures) for the following requirements of a simple database of National Hockey League (NHL). Specify all constraints that should hold on to the database and state any assumptions you make. [10]

The NHL has many teams, each team has a name, a city, a coach, a captain, and a set of players, each player belongs to only one team, each player has a name (first, last, middle), a position (such as left wing or goalie), and a skill level. There are two types of players, beginners, and experts. For

beginners the number of matches per day for training is more than the experts one. The trainers are just required for beginners and 90% attendance is required in training sessions to remain in the team. Team captain is also a player, a game is played between two teams (referred to as host_team and guest_team) and has a date (such as May 11th, 1999) and a score (such as 4 to 2). A player can also get an injury during a game. A description or record of injury is also maintained for each player.

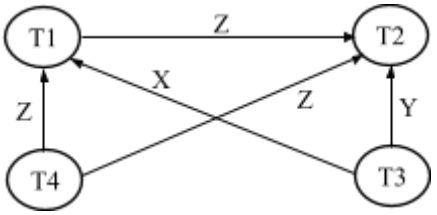
CLO # 3: Identify FDs and resolve database anomalies by normalizing database tables.

Q. No 3: Consider the following schedule of four transactions T1, T2, T3, and T4.

S: r1(X), r4 (Z), w1(Z), r3 (X), r3 (Y), w1 (X), w3 (Y), r2 (Y), w2 (Z), w2 (Y).

Draw the serializability (precedence) graph for this schedule. State whether this schedule is (conflict) serializable or not. If the schedule is serializable, write down the equivalent serial schedule(s) otherwise explain why it is not. [5]

Ans: It is conflict-serializable and equivalent serial schedules are T4□T3□T1□T2 and T3□T4□T1□T2. It is also view-serializable.



CLO # 3: Identify FDs and resolve database anomalies by normalizing database tables.

Q. No 4: Consider a relation R (A, B, C, D, E), with the set of FDs F= {C ⟶ D, B ⟶ ACE, AD ⟶ B}. Find all possible keys (i.e. candidate keys) of this relation? Prove it. [5]

Ans: Keys are Ans: B, AC, and AD.

CLO # 3: Identify FDs and resolve database anomalies by normalizing database tables.

Q. No 5: Consider the relation schema R (A, B, C, D, E), with FDs F= {ABC ⟶ D, AD⟶ B, E ⟶ C, A⟶ B, D⟶ A, BC ⟶ A}. Find a minimal cover of *F* (i.e. F_c). [5]

Ans: F_c= {~~A~~BC ⟶ D, ~~AD ⟶ B,~~ E ⟶ C, A⟶ B, D⟶ A, ~~BC ⟶ A~~}

i.e. F_c= {BC ⟶ D, E ⟶ C, A⟶ B, D⟶ A}.

CLO # 3: Identify FDs and resolve database anomalies by normalizing database tables.

Q. No 6: Consider the relation R (A, B. C, D, E), with FDs {A⟶ B, BC ⟶ D, E ⟶ C, D⟶ A}. State which of the following decompositions of R relation are lossless decomposition. Prove it. [5]

a. R1(C, E), R2(A, B), and R3(A, C, D).

b. R1(C, E), R2(A, B), and R3(A, D, E).

Ans: Keys of R are AE, BE, and DE.

a. Lossy decomposition. R1(C, E), R2(A, B), and R3(A, C, D); Only one cond. is true i.e. R2∩R3⟶R2.

b. Lossless decomposition. R1(C, E), R2(A, B), and R3(A, D, E); R1∩R3⟶R1 & R2∩R3⟶R2.

CLO # 3: Identify FDs and resolve database anomalies by normalizing database tables.

Q. No 7: Consider the relation schema R (A, B, C, D, E, G), with FDs F= {AB ⟶ C, CD ⟶ EG, EG ⟶ A, BC ⟶ D}. Keys of this relation are AB, BC, and BEG. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer. If R is not in BCNF, decompose it into a set of BCNF relations and show your steps. Indicate which dependencies if any are not preserved by the BCNF decomposition. [5]

Ans: HNF=3NF as FD2/FD3 violates BCNF.

BCNF Schema is R1(B, C, D), R2(C, D, E, G), R3(E, G, A). FD1: AB→C is lost.

Consider the following part of Library database for the next questions:
The NUCES library keeps records of the different reports submitted by students to the department, such as FYP Reports, MS thesis, and PhD thesis. Recently, the library added a new module, ***Report Rating***, that allows library users to rate and review the reports in the library database. This feature is beneficial for students looking for quality reports on a subject.

The Rating module includes Users, Reports, and Ratings. Users are identified by their unique ID, and have username, and gender. Each Report has a title, unique identifier (ReportID), year (publication year), and Subject (which can be a Database, Operating system, Algorithms, etc).
The authors of a Report are stored in the Report_Author table, as a report (such as an FYP report) can have multiple authors. **AuthorID is a foreign key and refers to UserID in the User table.** The Rating Table links Users and Reports and stores the user ratings and reviews on different Reports. The user gives a rating on a scale of 1-5.

USER

UserID	*UserName*	Gender
1	Ali	male
2	Ahmed	male
3	Hamza	male
4	kiran	female
5	Maria	female

REPORT

ReportID	*Title*	Subject	Year
1	Distributed DB for big data	Database	2010
2	Fraud detection using AI	Machine Learning	2023
3	Advanced leftist trees	Data Structure	2001
4	Applications of Neural Networks	Machine Learning	1994
5	AVL Trees	Data Structure	2000

REPORT_AUTHOR

ReportID	AuthorID
1	**1**
1	**2**
2	**3**
3	**4**
4	**5**
5	**1**

RATING

ReportID	*UserID*	UserRating	UserReview
1	**1**	4	Excellent
1	**2**	5	Highly recommended
3	**2**	3	Good read
4	**4**	4	Classic literature
5	**5**	2	Not my cup of tea

CLO # 4: Use SQL for database definition and manipulation in any DBMS.

Q. No 8: Consider the database state given above and for each of the following queries, give the output for the database state given above. [10]

a. SELECT u.username FROM User AS u
WHERE u.UserID IN (SELECT a.AuthorID FROM Report_Author AS a
WHERE a.AuthorID IN (SELECT b.UserID FROM Rating AS b
WHERE a.ReportID = b.ReportID));

Answer:

Username
Ali
Ahmed

b. SELECT b.ReportID, b.Title , COUNT(a.AuthorID) AS C
FROM Report b LEFT OUTER JOIN Report_Author a ON b.ReportID = a.ReportID
GROUP BY b.ReportID, b.Title;
Answer:

1	Distributed DB for big data	2
2	Fraud detection using AI	1
3	Advanced leftist trees	1
4	Applications of Neural Networks	1
5	AVL Trees	1

c. $\pi_{\text{UserID, UserName}}(\sigma_{\text{UserRating<3}}(\text{RATING} \bowtie_{\textit{Rating.userID=user.userID}} \text{USER}))$

userID	UserName
5	Maria

d. Subject $\Im_{\text{COUNT(Subject)}}$ (RATING * REPORT)

Subject	C
Database	2
Data Structure	2
Machiene Learning	1

CLO # 4: Use SQL for database definition and manipulation in any DBMS.

Q. No 9: Consider the above database for the following problems. [15]

a. Write **SQL and RA** statements to list the names and IDs of the Authors who have **only** written a Report on the Subject "Database".

```
SELECT A.AuthorID, U.name
FROM ReportAuthor A JOIN Report R ON A.ReportID = R.ReportID JOIN User U ON A.AuthorID
= U.userID
WHERE R.Subject = 'Database' AND A.AuthorID NOT IN (
                    SELECT A1.AuthorID
                    FROM ReportAuthor A1 JOIN Report R1 ON A1.ReportID = R1.ReportID
                    WHERE R1.Subject <> 'Database' );
```

- $NonDBAuthors = \pi_{\{AuthorID\}} (ReportAuthor * \{\sigma_{\{Subject<>'Database'\}} (Report)\})$
- $DBAuthors = \pi_{\{AuthorID\}} (ReportAuthor * \sigma_{Subject='Database'}(Report))$
- $OnlyDBAuthors = DBAuthors - NonDBAuthors$
- $AuthorNames = \pi_{\{AuthorID,\ name\}} (User \bowtie OnlyDBAuthors)$

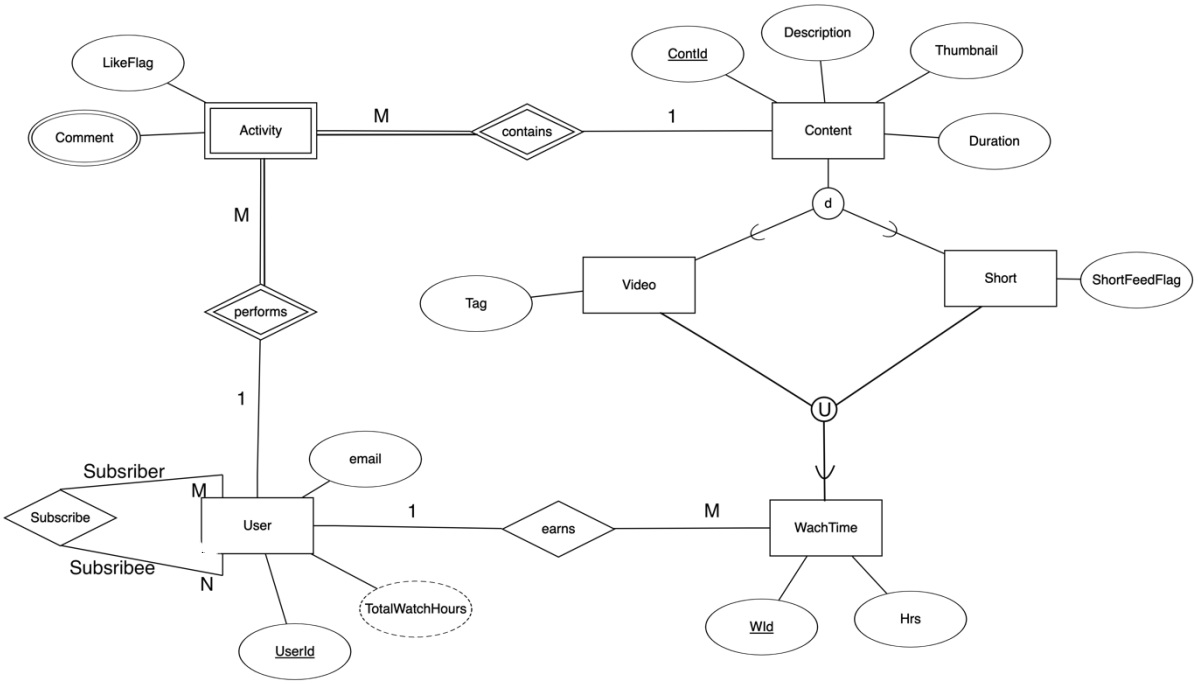
b. Write **SQL and RA** statements to list the names of the male users who have reviewed ***all*** the Reports rated 3 or above by the user "Damam Shah" with UserID=101.

```
SELECT    UserNAME
FROM      USER U
WHERE     Gender = 'Male' and
NOT EXISTS (
          (SELECT  ReportID    FROM Rating r
          WHERE     rating>=3 and r.UserID=101)
                EXCEPT
     (SELECT      ReportID
     FROM         Rating R
     WHERE        U.UserID= R.USerID)      )
```

- U1 ← $\pi_{ReportID} (\sigma_{rating>=3 \text{ and } r.UserID=101} Rating)$
- U2 ← $\pi_{UserID,\ ReportID} (Rating)$
- U3← **(U2 ÷ U1)**
- **Result** ← $\pi_{UserName}$ {U3 * $\sigma_{gender='Male'}$ User }

c. Create a ***View*** that lists the ReportID, Title, MaximumRating, and the number of reviews received for the Report, **but** only for the Reports with a minimum rating above 3 and written by 2 or more authors.

```
CREATE VIEW HighRatedReports AS
SELECT R.ReportID, R.Title, MAX(Rating.UserRating) AS MaximumRating,
COUNT(Rating.ReportID) AS NumReviews
FROM Report R JOIN ReportAuthor RA ON R.ReportID = RA.ReportID JOIN Rating ON
R.ReportID = Rating.ReportID
GROUP BY R.ReportID, R.Title
HAVING MIN(Rating.UserRating) > 3 AND COUNT(DISTINCT RA.AuthorID) >= 2;
```



Solution

User

UserId	email	TotalWatchHours

Subscribe

SubscriberUser Fk (User)	SubscribedUser Fk (User)

WatchTime

WId	Hrs	UserId Fk (User)

Content

ContId	Description	Thumbnail	Duration

Short

ShortFeedFlag	ContId Fk (Content)	WId Fk (WatchTime)

Video

Tags	ContId Fk (Content)	WId Fk (WatchTime)

Activity

UserId Fk (User)	ContId Fk (Content)	LikeFlag

ActivityComment

UserId Fk (Activity)	ContId Fk (Activity)	Comment