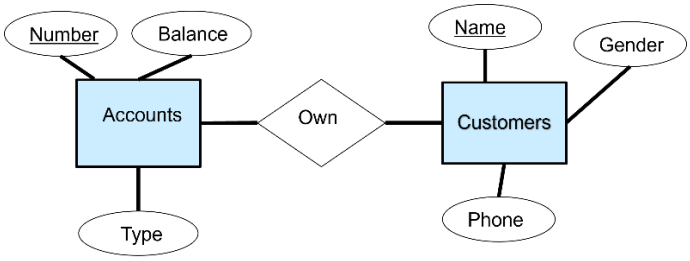
Midsem Exam 2024, DBMS

Maximum Marks: 35 **Time: 1 hour**

Q1: Consider the below ER-model and the corresponding relations Accounts and Customers.



Accounts

ANum	Type	Balance
11111	Saving	20000
22222	Current	400000
33333	Saving	10000

Customers

Name	Gender	Phone	AccNo
Rishi	Male	26907523	11111
Megha	Female	26907000	22222
Sachin	Male	26900800	11111
Sushma	Female	26908700	33333
Rishi	Male	26907523	33333

a) [2 Marks] What are the primary keys and foreign keys of each relation as per the given context. In case there is no primary key or foreign key, write '-'.

Answer:

Relation Name	Primary Key	Foreign Key
Accounts	ANum	-
Customers	Name,AccNo	AccNo

½ marks for each correct key identification for a relation. [1/2 * 4 = 2]

b) [2 Marks] Assume that the DBA deletes all the records of table Customers and then executes the following statement before entering the data again.

ALTER TABLE Customers ADD UNIQUE(NAME).

i) What are the implications of the ALTER statement with respect to the insertion of the data back into the table?

Ans: i) The DBA would not be able to insert the records back into the table in the case one customer has multiple accounts. For example, Rishi records cannot be inserted in the table.

1 marks for the correct reason. Partially correct reason would fetch 0 marks.

ii) Suggest a solution in terms of new Relational Schema the DBA can design, if she wants to capture the same facts but with keeping the unique constraint on the NAME attribute of Customer table and the semantics of the original ER model.

Ans. Solution-1: The DBA can create a table Owns(**Anum, Name**). Also the Customers relation is modified by dropping the AccNo attribute. This shall allow the DBA ro capture many to many relationships between Accounts and Customers as well, keep the unique constraint on Name attribute, and also satisfy the semantics of the ER-model.

Solution-2: The DBA can modify the table Accounts by adding an attribute Name, that would be a foreign key to the relation Customers. Drop the AccNo attribute from the Customers table.

1 marks for the correct answer. Partially correct answer would be given 0 marks.

c) [2 Marks] The DBA wants to add a scenario of associating a Demat account of customer with their Bank Accounts. She executes the following statements for this.

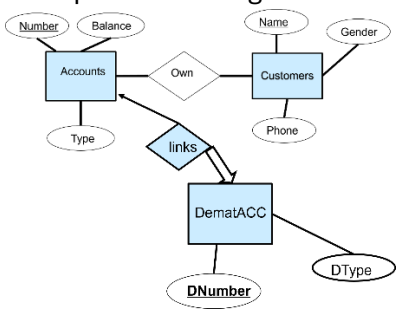
CREATE TABLE DAccount(DematACC NUMBER(10) NOT NULL, DTYPE VARCHAR(10), BAccount NUMBER(10) UNIQUE REFERNCES ACCOUNTS(Anum));

Draw the updated ER model with proper cardinality and participation constraints that captures the resultant relational schema.

Ans: From the table definition statement we get the following information:

1. There is a unique property for the bank account numbers, i.e., bank account numbers can not repeat. Also the value of the bank account being unique, it cannot be NULL. Hence, **there is a total participation of the demat entities**.
2. As the bank account number is unique in the table, **there cannot be two demat account entities associated with a single bank account**.
3. The bank account number is a foreign key in the table. It does not ensure every bank account should participate. Therefore, **it is a partial participation for the bank accounts**.
4. As the bank account is unique, **there can not be more than one bank account associated with a demat account**.

The updated ER diagram is as follows:

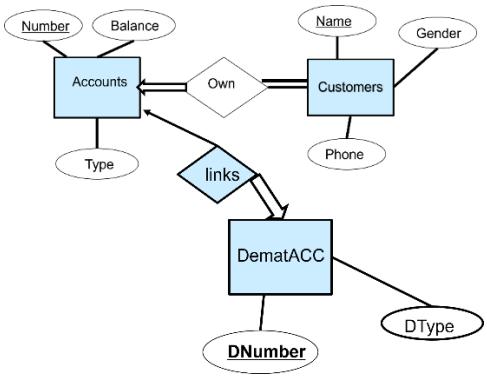


½ marks for each of the correct identification of the cardinality/participation constraint. [1/2 * 4 = 2 marks.] Note that name of the relation and attributes can be any but should just reflect the semantics.

d) [2 Marks] Assume that the Bank limits each customer to have exactly one account in the Bank. Each Account will have at least one associated customer.

Give the updated ER diagram, Relational Schema, and identify the Primary and Foreign keys for each relation.

Ans.



Relational Schema:

Accounts(Anum, Type, Balance)

Customers(Name, Gender, Phone, BAccount)

Relation Name	Primary Key	Foreign Key
Accounts	ANum	-
Customers	Name	BAccount

Evaluate only the relationship between Accounts and Customers. 1 marks for correct ER diagram (binary marking). 1/2 marks for correct relational schema.

½ marks for correct primary and foreign keys of relations. Only awarded if relational schema is correct. Note that attribute names and relation names can be any.

Q2 a) [4 Marks] Consider the relation instances as given in Q1-(a). Give the output results for each of the below given relational algebraic expressions. [Remember relational algebra works on Set Semantics.]

i) $\pi_{Name}(\sigma_{Balance \geq 20000 \text{ and } Accounts.ANum=Customers.AccNo}(Customers \times Accounts)) \cap \pi_{Cust1.Name}(\sigma_{Cust1.Name=Cust2.Name \text{ AND } Cust1.AccNo <> Cust2.AccNo}(\rho_{Cust1(Customers)} \times \rho_{Cust2(Customers)}))$

Ans.

Name
Rishi

2 marks if the correct answer. Binary marking.

ii) $\pi_{AccNo}(Customers) \times \pi_{Type}(Accounts)$

AccNo	Type
11111	Saving
11111	Current
22222	Saving
22222	Current
33333	Saving
33333	Current

2 marks in the case of correct answer. Binary marking.

b) [4 Marks] Consider the relation instances as given in Q1-(a). Give the output results for each of the below given SQL queries.

i) SELECT NAME, BALANCE
FROM ACCOUNTS, CUSTOMER
WHERE ANUM=ACCNO AND BALANCE > 15000;

Ans.

Name	Balance
Rishi	20000
Megha	400000
Sachin	20000

2 marks for correct answer. Binary marking.

ii) SELECT GENDER, COUNT(*) MyXCustomers
FROM Accounts, Customers
WHERE TYPE=”Saving” AND Anum= AccNo
GROUP BY GENDER;

Ans.

Gender	MyXCustomers
Male	3
Female	1

2 marks for correct answer. Binary marking.

Q3: [2 Marks] Consider a relation Performance(Student_id, DSA_marks, DBMS_marks) with the relation instance as given below.

Student_id	DSA_marks	DBMS_marks
1111	45	NULL
2222	NULL	90
3333	100	65

For the SQL query as given below:

SELECT student_id FROM Performance WHERE (DSA_marks > DBMS_marks AND DSA_marks > 35 AND DBMS_marks > 70) OR (DSA_marks < 50);

Which students tuples are returned?

Ans.

Student_id
1111

2 marks for the correct answer. Binary marking.

Q4: [Total: 4 Marks]

i) [2 Marks] Comment whether the below two queries are equivalent or not for all the possible instances of the relation. Illustrate with a relation instance of

Employee(age, salary) that's correctly comments on Equivalency/Not-Equivalency of the queries.

Query-1: SELECT * FROM Employee;

Query-2: (SELECT * FROM Employee) INTERSECT (SELECT * FROM Employee);

Ans. They are not equivalent as the first query result is a bag relation and the second query result is a set relation. The relation instance of Employee that would give different results is

age	salary
20	20000
20	20000

Award marks only when both not equivalency as well as a correct relation instance showing the issue is given. No marks otherwise. Binary marking.

ii) [2 Marks] Comment whether the two below queries are equivalent or not on all the possible instances of relations StdContact(**phone CHAR(10)**, address VARCHAR(20)), and Std(**name** VARCHAR(30), phone CHAR(10), Std(phone) references StdContact(phone)). Illustrate with relation instances that's correctly comments on Equivalency/Not-Equivalency of the queries.

Query-1: SELECT phone FROM StdContact;

Query-2: SELECT phone FROM Std;

Ans. They are no equivalent. It is not necessary for the Std relation to refer to every phone of the StdContact relation. Example instances of StdContact and Std are as follows:

phone	**address**
26907414	IIIT Delhi
26907480	IIIT Delhi

StdContact

name	**phone**
Arjun	26907414

Std

Award marks only when both not equivalency as well as a correct relation instances showing the issue are given. No marks otherwise. Binary marking.

Q5: (Challenging SQL and Relational Algebraic expression)

a) [4 Marks] Write an SQL query for computing the relation *Successor(std_id-1,std_id-2)* from the table *Student(**std_id**, rank)* such that std_id-2 is the immediate successor of std_id-1 as per the rank, i.e., there is not any other student between std_id-1 and std_id-2, whose rank is more than std_id-1's rank and less than std_id-2's rank. Below is given an example instance of Student and corresponding output for your perusal.

std_id	**rank**
A01	5
A06	3
A08	1
A09	13
A11	2

INPUT

Std_id-1	**Std_id-2**
A08	A11
A11	A06
A06	A01
A01	A09

OUTPUT

Ans.

```
SELECT Std1.Std_id-1, Std2.Std_id-2
FROM Student Std1, Student Std2
WHERE Std1.rank  < Std2.rank AND
        NOT EXISTS (SELECT std_id FROM Student S WHERE S.rank > Std1.rank AND S.rank < Std2.rank );
```

Binary marking. There can be other correct answers as well.

b) [4 Marks] Give a relational algebraic expression for the relational schema of Q1-(a) for listing all the customers who have only Current Accounts. [The query expression should work for any possible relations instances.]

Ans.

$$\pi_{Name}(\boldsymbol{Customers}) - \pi_{Name}(\sigma_{ANum=AccNo\ AND\ Type="Saving"}(\boldsymbol{Customers} \times \boldsymbol{Accounts}))$$

4 marks for the correct answers. Only binary marking. Note there can be multiple correct answers.

Q6: Consider relation R(A,B,C,D,E) with FDs set F = {A-> B, AB->CD, D->ABCE, A->C}

i) [3 Marks] Which of the following are super-keys of the relation R

a) A
b) AB
c) CD

Ans.

a) Closure of A is {A,B, C,D,E}. Therefore A is a super-key.
b) A is a super key. Hence AB would be a super-key.
c) Closure of CD is {A,B,C,D,E}. Hence CD is a super key.

1 marks for each correct answer.

ii) [2 Marks] Is the relation R in BCNF form? If not, which functional dependencies violate it.

Ans.

Yes, R is in a BCNF form as the LHS of each FD is a super-key.

There is no FD that violate the criteria.

1 marks for correctly identifying the BCNF form.

1 marks of mentioning that no FD is violating the criteria.