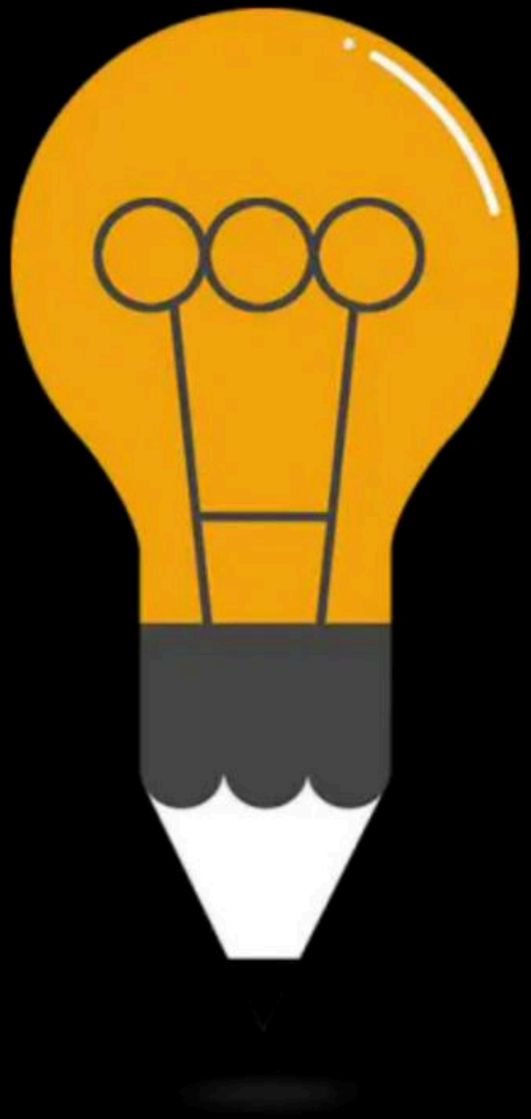
unacademy

Relational Algebra: Part II

Complete Course on Database Management System

Vishvadeep Gothi • Lesson 18 • July 11, 2023

unacademy



DBMS

Relational Algebra 2

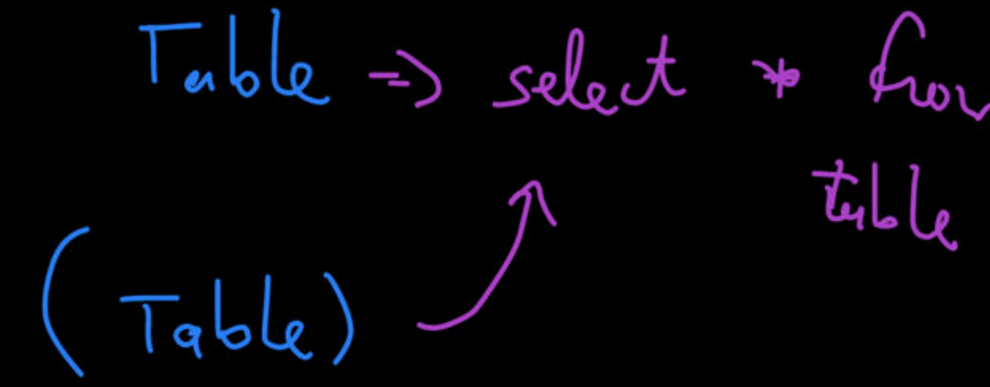
By: Vishvadeep Gothi

unacademy

Relational Algebra

Basics Operators:

1. Select (σ)
2. Project (∏)
3. Union (∪)
4. Set Difference (−)
5. Intersection (∩)
6. Cartesian Product (X)
7. Rename (ρ)
8. Division (÷)



unacademy

Select → same a where in SQL

The SELECT operator chooses those tuples in the output that satisfy the specified condition.

$\sigma_{\text{<selection-condition>}}$ (Relation name)

unacademy

Select

Eid	Ename	Rating	Age
101	Richa	7	24
105	Rohan	9	20
120	Mahesh	8	26
145	Abhishek	10	29

To select those tuples of sailors relation where rating is greater than 8

$\sigma_{rating>8}(Sailors)$

Select

Comparison operators that can be used in selection conditions are:

<, <=, =, ≠, >=, >

The select operation is commutative i.e.

$$\sigma_{<\text{cond 1}>}(\sigma_{<\text{cond 2}>}(R)) = \sigma_{<\text{cond 2}>}(\sigma_{<\text{cond 1}>}(R)) = \sigma_{\text{Cond 1} \wedge \text{Cond 2}}(R)$$

and ⇒ ∧

or ⇒ ∨

Ques) Products (Pid, Pname, category, Price)

Find all products with prices b/w 15 and 30.

$$\sigma_{Price >= 15 \wedge Price <= 30} (Products)$$

unacademy

Project → like select of SQL

The project operation is used to choose certain columns from the table and trashes out the other attribute fields

A projection is a unary operation written as $\Pi_{A1, A2, \ldots, An}(r)$

customers(cid, cname, city, country)

Find name of all customers

$\Pi_{cname}(customers)$ ← distinct names

unacademy

Project

Fetch only Ename and salary of all employees from employee relation

Eid	Ename	Salary	Dno	Sex
101	Raman	30,000	1	M
102	Sneha	20,000	1	F
103	Maya	20,000	2	F
104	Ranjith	20,000	2	M
105	Mahesh	15,000	3	M

$\Pi_{Ename, Salary}$ (Employee)

Π_{Salary} (Employee)

Salary
30000
20000
15000

unacademy

R

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

$$\Pi_{A,B}(R)$$

A	B
1	2
3	1
3	2

unacademy

Project

The project operation results in a set of a distinct tuple as the Project operation removes duplicate tuples

---

Sequence :-

Π (σ (Relation))

unacademy

Project

Write a relation algebra statement to find name of all such employees from department no 2 whose salary is greater than 17000

Eid	Ename	Salary	Dno	Sex
101	Raman	30,000	1	M
102	Sneha	20,000	1	F
103	Maya	20,000	2	F
104	Ranjith	20,000	2	M
105	Mahesh	15,000	3	M

$\pi_{Ename}(\sigma_{dno=2 \wedge Salary>17000}(Employee))$

fetch name and dno of all male employees who are having salary less than 30000.

$$\Pi_{Ename, dno} \left(\sigma_{sex = 'M' \wedge salary < 30000} (Employee) \right)$$

unacademy

Set Operations

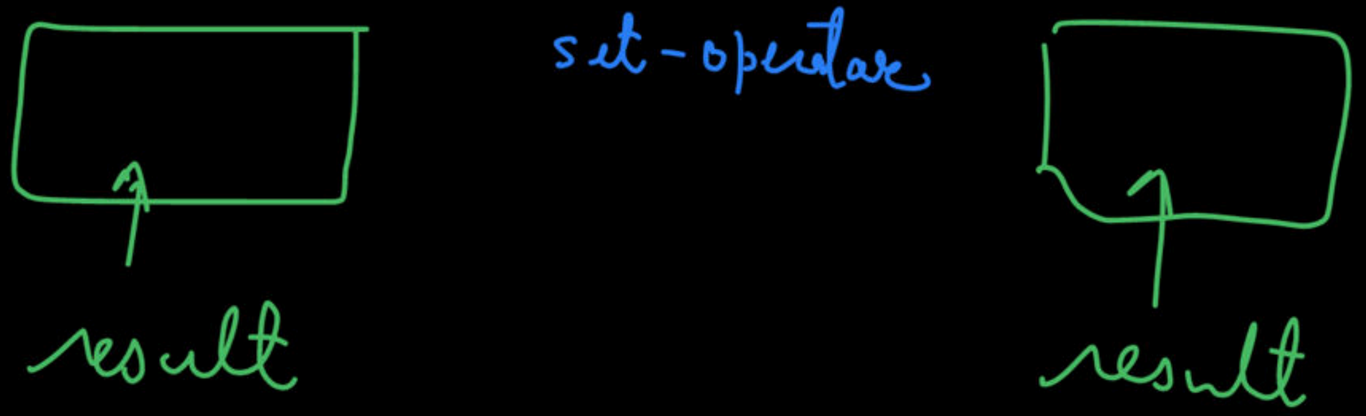
1) Union ∪
2) Intersection ∩
3) Set-difference —

} operation performed on tuples

unacademy

Set Operations

The two relations on which set operations are implemented upon must necessarily have similar data types of tuples. This condition is called type or union compatibility.



=> no. of columns & data-type of corresponding columns

unacademy

Example

E1

Eid	Ename	Age	Rating
20	Somya	24.0	7
30	Rahul	25.0	8
40	Ranjith	24.0	9
50	Yashvi	23.0	10
60	Sonam	27.0	8

E2

Eid	Ename	Age	Rating
30	Rahul	25.0	8
35	Satyam	24.0	9
50	Yashvi	23.0	10
60	Sonam	27.0	8

E1 ∪ E2 ⇒

Eid	Ename	Age	Rating
20	Somya	24.0	7
30	Rahul	25.0	8
40	Ranjith	24.0	9
50	Yashvi	23.0	10
60	Sonam	27.0	8

$$\left(\pi_{Ename}(E_1)\right) \cup \left(\pi_{Ename}(E_2)\right)$$

Ename
Sonya
Rahul
Ranjith
Yashi
Sonam
satyam

$$\left(\pi_{Age}(E_1)\right) \cup \left(\pi_{Age}(E_2)\right)$$

Aye
24.0
25.0
23.0
27.0

unacademy

$(E1) \cap (E2)$

Eid	Ename	Age	Rating
30	Rahul	25.0	8
50	Yashvi	23.0	16
60	Sonam	27.0	8

$(E1) - (E2)$

all those tuples of E1 which are not present in E2

Gid	Ename	Age	Rating
20	Somya	24.0	7
40	Ranjith	24.0	9

unacademy

E2 − E1

Eid	Ename	Age	Rating
35	satyam	24.0	9

Question

Consider 2 relations Students(rno, sname, dob) and Employees(eId, ename, salary)

Write a relational algebra statement for corresponding SQL Query:

Select distinct sname from Students where dob='27-10-1988' Union Select distinct ename where salary>15000

$$\Pi_{sname}\left(\sigma_{dob='27\text{-}10\text{-}1988'}(students)\right) \cup$$

$$\Pi_{ename}\left(\sigma_{salary>15000}(Employees)\right)$$

unacademy

Set Operations

Union and intersection are commutative and associative

Commutative :-

$R1 \cup R2 = R2 \cup R1$

$R1 \cap R2 = R2 \cap R1$

Associative :-

$R1 \cup (R2 \cup R3) = (R1 \cup R2) \cup R3$

$R1 \cap (R2 \cap R3) = (R1 \cap R2) \cap R3$

unacademy

Question

Consider 2 relations R1(x,y) and R2(x,y). R1 and R2 contains all Not NULL values.

Will the following 2 statements be equivalent or not?

$\pi_x(R1 \cup R2)$

$(\pi_x(R1)) \cup (\pi_x(R2))$

yes

R_1	
x	y
1	2
1	3
1	4
2	1
2	2
2	1
3	4

R_2	
x	y
1	2
1	4
2	1
3	2
3	3

$R_1 \cup R_2$	
1	2
1	3
1	4
2	1
2	2
3	4
3	3
4	2

1
2
3

unacademy

Question

Consider 2 relations R1(x,y) and R2(x,y). R1 and R2 contains all Not NULL values.

Will the following 2 statements be equivalent or not?

$\pi_x(R1 \cap R2)$

$\pi_x(R1) \cap \pi_x(R2)$

No

R1

x	y
1	2
3	4
1	3
2	4

R2

x	y
1	2
1	4
3	5
2	3

$\pi_x(R1 \cap R2)$ ⇒

x
1

$(\pi_x(R1) \cap (\pi_x(R2))$

x
1
2
3

Ques) Employee(Eno, Ename, dno, Gender, salary)

write a R.A. Query to list out Eno, name and department no of male employees having salary over 20000 and female employees having salary over 25000

Soln

$$\left(\pi_{Eno, Ename, dno}\left(\sigma_{Gender = 'm' \wedge salary > 20000}(Employee)\right)\right) \cup$$

$$\left(\pi_{Eno, Ename, dno}\left(\sigma_{Gender = 'F' \wedge salary > 25000}(Employee)\right)\right)$$

unacademy

Cartesian Product (cross product)

R x S

R

A	B	C
1	a	b
2	c	d
3	e	f

S

D	E
1	c
2	d

A	B	C	D	E
1	a	b	1	c
1	a	b	2	d
2	c	d	1	c
2	c	d	2	d
3	e	f	1	c
3	e	f	2	d

unacademy

Cartesian Product

A	B	C
1	a	b
2	c	d
3	e	f

D	E
1	c
2	d

A	B	C	D	E
1	a	b	1	c
2	c	d	2	d

$$\sigma_{A=D}(R \times S)$$

R1

A	B	C
1	b_1	c_1
2	b_2	c_2
3	b_3	c_1
4	b_3	c_2

R2

A	D	E
1	d_1	e_1
3	d_2	e_1
3	d_3	e_1

$$\pi_{R1.A}\left(\sigma_{R1.A = R2.A}\left(R1 \times R2\right)\right)$$

$\Downarrow$

R1.A					
1	b_1	c_1	1	d_1	e_1
3	b_3	c_1	3	d_2	e_1
3	b_3	c_1	3	d_3	e_1

R1.A
1
3

unacademy

Joins

1. Condition Join ⇒ join Condition ⇒ >, <, >=, <=
2. Equi Join ⇒ — " — ⇒ =
3. Natural Join

$$R1 \bowtie_{condition} R2$$

unacademy

Condition Join

E

Eid	Ename	Rating	Age
20	Ravish	8	24.0
30	Radha	7	25.0
40	Shyam	9	26.0

P

Eid	Pid	Day
20	120	2/8/21
40	115	5/6/21

$$E \bowtie_{E.Eid<P.Eid} P$$

20 Ravish 8 24.0 40 115 5/6/21

30 Radha 7 25.0 40 115 5/6/21

$$\sigma_{E.Eid < P.Eid} (E \times P)$$

unacademy

Equi Join

Employee

Eno	Ename	Sex	Age
101	Ravi	M	24.0
102	Satyam	M	25.0
103	Meera	F	23.0
104	Rohan	M	27.0

Drives

EmpNo	Car
101	Volvo
103	Mercedes
104	Jaguar
104	Toyota

$$Employee \bowtie_{Employee.ENo=Drives.EmpNo} Drives$$

101	Ravi	M	24.0	101	volve
103	Meera	F	23.0	103	Mercedes
104	Rohan	M	27.0	104	Jaguar
104	Rohan	M	27.0	104	Toyota

unacademy

Natural Join ⇒ implicitely equi join is used for all Common columns

Student

Rollno	Student_name
1	Amit
2	Priya
3	Rohan
4	Komal

Performance

Rollno	Subject_code	Marks
1	A	84
1	B	90
2	C	92
3	A	85

$$Student \bowtie Performance$$

1	Amit	1	A	84
1	Amit	1	B	90
2	Priya	2	C	92
3	Rohan	3	A	85

unacademy

R1

A	B	C
1	2	3
1	4	5
2	6	7

R2

A	B	D
1	2	4
1	3	5
2	6	9

$R1 \bowtie R2 \Rightarrow$

A	B	C	A	B	D
1	2	3	1	2	4
2	6	7	2	6	9

unacademy

Question

Find the name of the customers who have placed atleast one order shipped by shippedID 3?

customers (cid, cname, country, city, postalcode)

orders (oid, cid, eid, shipperid)

Π_{cname}

$(\sigma_{shipperid=3}(customers \bowtie orders))$

unacademy

Question

Consider following relations:

Drivers (did, dname, rating)

Cars (cid, cmodel, ccolor)

Drives (Did, cid, dateofRace)

Write a query to find all such drivers name who have driven blue color car?

unacademy

Question

Write a query to find all such drivers name who have driven blue color car or Black color car?

unacademy

Question

Write a query to find all such drivers name who have driven blue color car or Black color car?

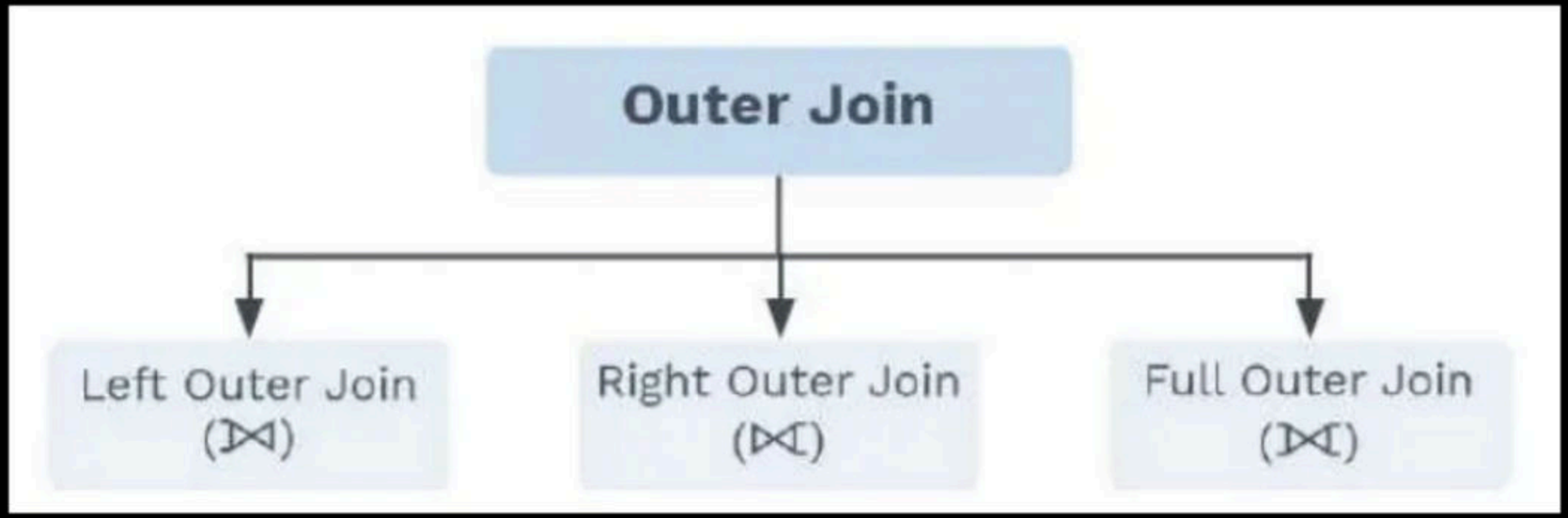
unacademy

Question

Write a query to find all such drivers name who have driven blue color car and Black color car?

unacademy

Outer Join



unacademy

Rename Operator

Rename (ρ)

Rename Operator

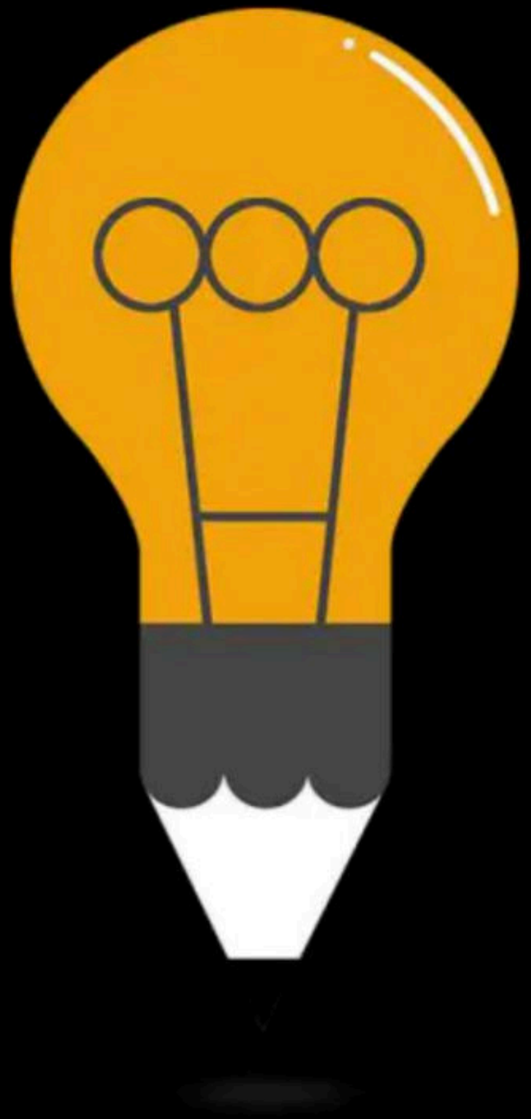
$\rho_{\text{newname}}(\text{original})$

unacademy

Rename Operator

$\rho_{newname(c1, c2, \ldots.. cn)}$ (original)

unacademy



DPP: RA

By: Vishvadeep Gothi

unacademy

Customers Table

CustomerID	CustomerName	ContactName	Address	City	PostalCode	Country
1	Alfreds Futterkiste	Maria Anders	Obere Str. 57	Berlin	12209	Germany
2	Ana Trujillo Emparedados y helados	Ana Trujillo	Avda. de la Constitución 2222	México D.F.	05021	Mexico
3	Antonio Moreno Taquería	Antonio Moreno	Mataderos 2312	México D.F.	05023	Mexico
4	Around the Horn	Thomas Hardy	120 Hanover Sq.	London	WA1 1DP	UK
5	Berglunds snabbköp	Christina Berglund	Berguvsvägen 8	Luleå	S-958 22	Sweden
6	Blauer See Delikatessen	Hanna Moos	Forsterstr. 57	Mannheim	68306	Germany
7	Blondel père et fils	Frédérique Citeaux	24, place Kléber	Strasbourg	67000	France
8	Bólido Comidas preparadas	Martín Sommer	C/ Araquil, 67	Madrid	28023	Spain

unacademy

Question

Write query for all below questions on table Customers

1. Select all customers which are from country "Germany“, "Berlin“
2. Fetch that customers’ name, address city, postal code and country who has contact name ‘Yang Wang’
3. Fetch all customers information till customerID 19
4. Fetch all customers information except from Country ‘Germany’, ‘UK’, ‘USA’

unacademy

Products Table

ProductID	ProductName	SupplierID	CategoryID	Unit	Price
1	Chais	1	1	10 boxes x 20 bags	18
2	Chang	1	1	24 - 12 oz bottles	19
3	Aniseed Syrup	1	2	12 - 550 ml bottles	10
4	Chef Anton's Cajun Seasoning	2	2	48 - 6 oz jars	22
5	Chef Anton's Gumbo Mix	2	2	36 boxes	21.35
6	Grandma's Boysenberry Spread	3	2	12 - 8 oz jars	25
7	Uncle Bob's Organic Dried Pears	3	7	12 - 1 lb pkgs.	30
8	Northwoods Cranberry Sauce	3	2	12 - 12 oz jars	40
9	Mishi Kobe Niku	4	6	18 - 500 g pkgs.	97
10	Ikura	4	8	12 - 200 ml jars	31
11	Queso Cabrales	5	4	1 kg pkg.	21
12	Queso Manchego La Pastora	5	4	10 - 500 g pkgs.	38
13	Konbu	6	8	2 kg box	6
14	Tofu	6	7	40 - 100 g pkgs.	23.25
15	Genen Shouyu	6	2	24 - 250 ml bottles	15.5

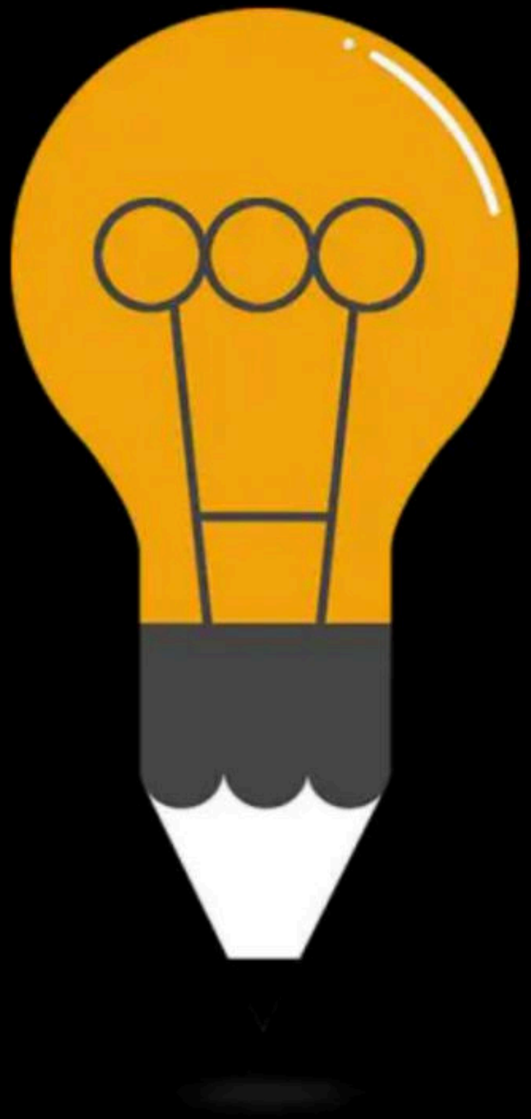
unacademy

Question

Write query for all below questions on table Products

1. Select all products which are supplied by suppliers with Id 1 or 2 or 3
2. Fetch the name of all such products which have price in range 5 to 25
3. Find all suppliers who supply the products of category 2?
4. Find all products which are supplied by supplier of ID 2 with price more than 30?
5. Find all products which have price more than 50 but not supplied by supplier with ID 6?
6. Find all products which have price less than 30 but not supplied by supplier with ID 2 or 6?

unacademy



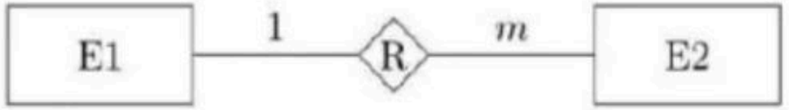
PYQ:

ER Diagram

By: Vishvadeep Gothi

Question GATE-2004

Consider the following entity relationship diagram (ERD), where two entities $E1$ and $E2$ have a relation R of cardinality 1:m.



The attributes of $E1$ are $A11$, $A12$ and $A13$ where $A11$ is the key attribute. The attributes of $E2$ are $A21$, $A22$ and $A23$ where $A21$ is the key attribute and $A23$ is a multi-valued attribute. Relation R does not have any attribute. A relational database containing minimum number of tables with each table satisfying the requirements of the third normal form ($3NF$) is designed from the above ERD. The number of tables in the database is

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

unacademy

Question GATE-2005

Let E_1 and E_2 be two entities in an E/R diagram with simple-valued attributes. R_1 and R_2 are two relationships between E_1 and E_2, where R_1 is one-to-many and R_2 is many-to-many. R_1 and R_2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model?

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

unacademy

Question GATE-2005

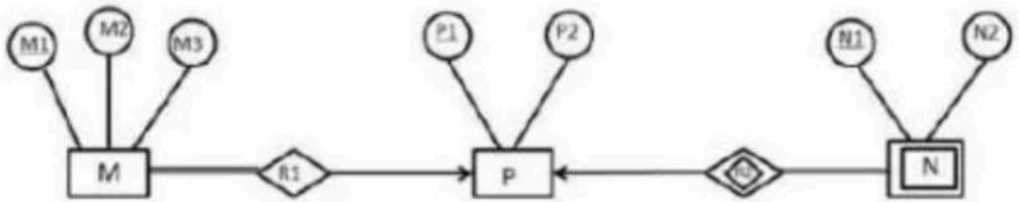
Consider the entities 'hotel room', and 'person' with a many to many relationship 'lodging' as shown below:

If we wish to store information about the rent payment to be made by person (s) occupying different hotel rooms, then this information should appear as an attribute of

A. Person B. Hotel Room C. Lodging D. None of these

Question GATE-2008

Consider the following ER diagram

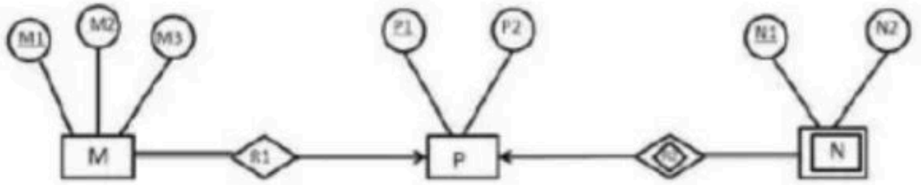


The minimum number of tables needed to represent M, N, P, $R1$, $R2$ is

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

Question GATE-2008

Consider the following ER diagram



The minimum number of tables needed to represent M, N, P, $R1$, $R2$ is

Which of the following is a correct attribute set for one of the tables for the minimum number of tables needed to represent M, N, P, $R1$, $R2$?

A. $M1, M2, M3, P1$ B. $M1, P1, N1, N2$ C. $M1, P1, N1$ D. $M1, P1$

unacademy

Question GATE-2012

Given the basic ER and relational models, which of the following is **INCORRECT**?

A. An attribute of an entity can have more than one value
B. An attribute of an entity can be composite
C. In a row of a relational table, an attribute can have more than one value
D. In a row of a relational table, an attribute can have exactly one value or a NULL value

unacademy

Question GATE-2015

Consider an Entity-Relationship (ER) model in which entity sets E_1 and E_2 are connected by an m:n relationship R_{12}. E_1 and E_3 are connected by a $1:n$ (1 on the side of E_1 and n on the side of E_3) relationship R_{13}.

E_1 has two-singled attributes a_{11} and a_{12} of which a_{11} is the key attribute. E_2 has two singled-valued attributes a_{21} and a_{22} of which a_{21} is the key attribute. E_3 has two single-valued attributes a_{31} and a_{32} of which a_{31} is the key attribute. The relationships do not have any attributes.

If a relational model is derived from the above ER model, then the minimum number of relations that would be generated if all relation are in $3NF$ is_____.

unacademy

Question GATE-2017

An ER model of a database consists of entity types A and B. These are connected by a relationship R which does not have its own attribute. Under which one of the following conditions, can the relational table for R be merged with that of A?

A. Relationship R is one-to-many and the participation of A in R is total
B. Relationship R is one-to-many and the participation of A in R is partial
C. Relationship R is many-to-one and the participation of A in R is total
D. Relationship R is many-to-one and the participation of A in $R$is partial

unacademy

Question GATE-2018

In an Entity-Relationship (ER) model, suppose R is a many-to-one relationship from entity set E1 to entity set E2. Assume that E1 and E2 participate totally in R and that the cardinality of E1 is greater than the cardinality of E2.

Which one of the following is true about R?

A. Every entity in E1 is associated with exactly one entity in E2
B. Some entity in E1 is associated with more than one entity in E2
C. Every entity in E2 is associated with exactly one entity in E1
D. Every entity in E2 is associated with at most one entity in E1

unacademy

Happy Learning.!