Relational Algebra Operations Set Operators

Set Operators

• Set operators combine the results of two or more queries into a single result.

Three types of Set Operators

Sr.	Set Operators	Symbol
1.	Union	U
2.	Intersect / Intersection	Λ
3.	Minus / Set difference	-

Conditions Set operators will take two or more queries as input, which must be union-compatible.

- Both queries should have same (equal) number of columns
- Corresponding attributes should have the same data type or domain

Conditions to perform Set Operators

Conditions-1 Both queries should have same (equal) number of columns.

Student			
RNo	Name	Dept	SPI
101	Raj	CE	8
102	Meet	ME	9
103	Jay	CE	9

Facu	Ity	
Fld	Name	Dept
101	Patel	CE
102	Shah	ME
103	Dave	ME

Stude	ent	
RNo	Name	Dept
101	Raj	CE
102	Meet	ME
103	Jay	CE

Faculty		
Fld	Name	Dept
101	Patel	CE
102	Shah	ME
103	Dave	ME

Conditions-2 Corresponding attributes should have the same data type.

Student				
RNo	Name	Dept	SPI	
101	Raj	CE	8	
102	Meet	ME	9	
103	Jay	CE	9	

rac	uity		
Fld	Name	Dept	Sub
101	Patel	CE	DS
102	Shah	ME	DBMS
103	Dave	ME	DF

Stud	ent		Y
RNo	Name	Dept	SPI
101	Raj	CE	8
102	Meet	ME	9
103	Jay	CE	9

Facu	Ity		
Fld	Name	Dept	Ехр
101	Patel	CE	5
102	Shah	ME	3
103	Dave	ME	4

Set Operators [Exercise]

Exercise Check whether following tables are compatible or not:

(Compatible) Both tables have 2 attributes and of same data type.

```
A: (First_name(char), Last_name(char), Date_of_Birth(date))
B: (FName(char), LName(char), PhoneNumber(number))
X (Not compatible) Both tables have 3 attributes but third attributes datatype is different.
A: (First_name(char), Last_name(char), Date_of_Birth(date))
B: (FName(char), LName(char), DOB(date))
(Compatible) Both tables have 3 attributes and of same data type.
Person (PersonID, Name, Address, Hobby)
Professor (ProfessorID, Name, OfficeAddress, Salary)
(Not compatible) Both tables have 4 attributes but forth attributes datatype is different.
\(\int_{Name, Address}\) (Person) & \(\int_{Name, OfficeAddress}\) (Professor)
```

Union Operator

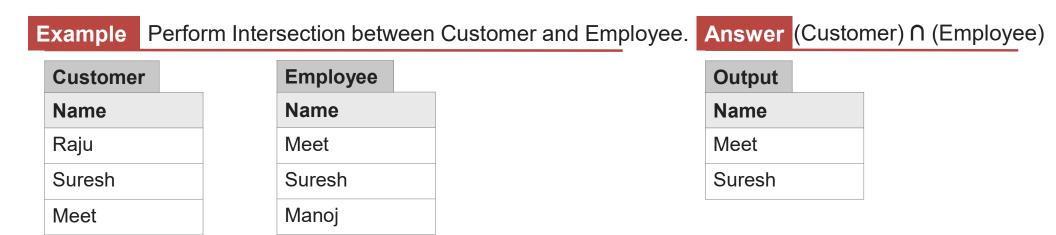
- Symbol: U
- Notation: Relation-1 (R1) U Relation-2 (R2) OR Algebra-1 U Algebra-2
- Operation:
 - It displays all the tuples/records belonging to the first relation (left relation) or the second relation (right relation) or both.
 - It also eliminates duplicate tuples (tuples present in both relations appear once).

Example	Perform Union between Custo	mer and Employee. Answ	wer (Customer) U (Employee)
Customer	Employee		Output	
Name	Name	1	Name	
Raju	Meet	N	Manoj	
Suresh	Suresh	N	Meet	
Meet	Manoj	F	Raju	
		5	Suresh	

Exercisthere any difference in the output if we swap the tables in Union operator. (Employee) **U** (Customer)

Intersect/ Intersection Operator

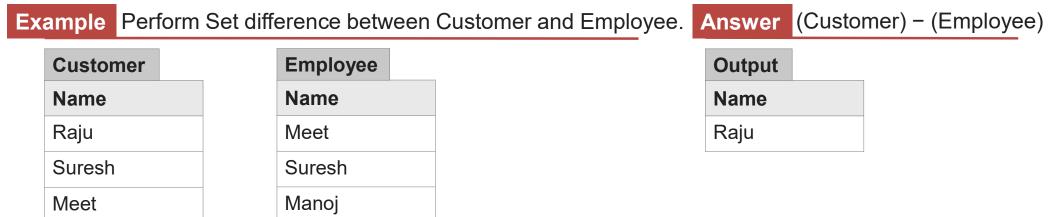
- Symbol: ∩
- Notation: Relation-1 (R1) ∩ Relation-2 (R2) OR Algebra-1 ∩ Algebra-2
- Operation:
 - It displays all the tuples/records belonging to both relations. OR
 - It displays all the tuples/records which are common from both relations.



Exercise there any difference in the output if we swap the tables in Intersection. (Employee) ∩ (Customer)

Minus/ Set difference Operator

- Symbol: -
- Notation: Relation-1 (R1) Relation-2 (R2) OR Algebra-1 Algebra-2
- Operation:
 - It displays all the tuples/records belonging to the first relation (left relation) but not in the second relation (right relation).



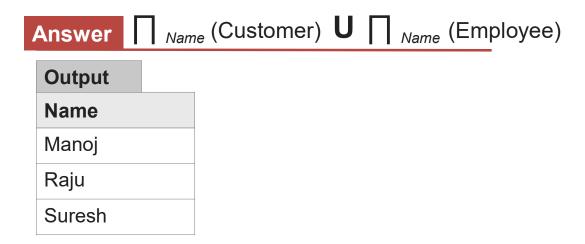
Exercistine re any difference in the output if we swap the tables in Set difference. (Employee) – (Customer).

Union Operators Example

Example Display Name of person who are either employee or customer.

Cus	stomer	
ID Name		Balance
1	Raju	10000
2	Suresh	20000

Em	ployee		
ID	Name	Dept	Salary
2	Suresh	CE	8000
3	Manoj	ME	9000

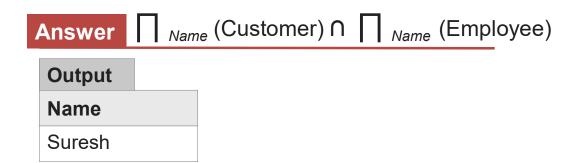


Intersect/ Intersection Operators Example

Example Display Name of person who are employee as well as customer.

Customer		
ID	Name	Balance
1	Raju	10000
2	Suresh	20000

Employee			
ID	Name	Dept	Salary
2	Suresh	CE	8000
3	Manoj	ME	9000

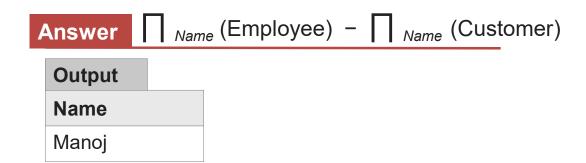


Minus/ Set difference Operators Example

Example Display Name of person who are employee but not customer.

Customer			Em	ploy
ID	Name	Balance	ID	Naı
1	Raju	10000	2	Sur
2	Suresh	20000	3	Ma

Employee			
ID	Name	Dept	Salary
2	Suresh	CE	8000
3	Manoj	ME	9000

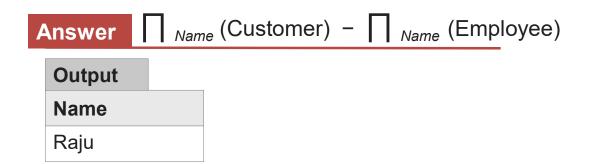


Minus/ Set difference Operators Example

Example Display Name of person who are customer but not employee.

Customer		
ID	Name	Balance
1	Raju	10000
2	Suresh	20000

Employee			
ID	Name	Dept	Salary
2	Suresh	CE	8000
3	Manoj	ME	9000



Set Operators [Exercise]

Exercise What is the output of following relational algebra for the below mentioned tables:

Customer		
ID	Name	Balanc e
1	Raju	10000
2	Suresh	20000

Employee			
ID	Name	Dept	Salary
2	Suresh	CE	8000
3	Manoj	ME	9000

Algebra-1	III _{ID, Name} (Customer) III _{ID, Name} (Employee)
Algebra-2	☐ ID, Name, Balance (Customer) U ☐ ID, Name, Salary (Employee)
Algebra-3	∏ _{ID, Name} (Customer) ∩ ∏ _{ID, Name} (Employee)
Algebra-4	∏ _{ID, Name, Balance} (Customer) ∩ ∏ _{ID, Name, Salary} (Employee)

Set Operators [Exercise]

Exercise What is the output of following relational algebra for the below mentioned tables:

Customer		
ID	Name	Balance
1	Raju	10000
2	Suresh	20000

Employee			
ID	Name	Dept	Salary
2	Suresh	CE	8000
3	Manoj	ME	9000

Algebra-1	
Algebra-2	☐ ID, Name, Balance (Customer) - ☐ ID, Name, Salary (Employee)
Algebra-3	☐ _{ID, Name} (Employee) - ☐ _{ID, Name} (Customer)
Algebra-4	$\prod_{ID, Name, Balance}$ (Employee) – $\prod_{ID, Name, Salary}$ (Customer)



Relational Algebra Operations Division Operator



Division Operator

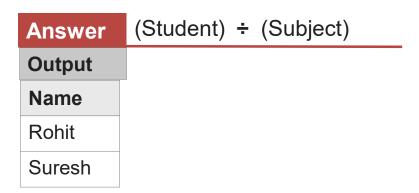
- Symbol: ÷ (Division)
- Notation: Relation1 (R1) ÷ Relation2 (R2) OR Algebra1 ÷ Algebra2
- Condition:
 - Attributes of relation2/algebra2 must be a proper subset of attributes of relation1/algebra1.
- Operation:
 - The output of the division operator will have attributes =
 All attributes of relation1 All attributes of relation2
 - The output of the division operator will have tuples =
 Tuples in relation1, which are associated with the all tuples of relation2.

Division Operator Example

Example Perform Division operation between Student and Subject.

Student	
Name	Subject
Raj	DBMS
Raj	DS
Meet	DS
Meet	DF
Rohit	DBMS
Rohit	DS
Rohit	DF
Suresh	DBMS
Suresh	DF
Suresh	DS

Subject	
Subject	
DBMS	
DS	
DF	



Division Operator Example

S4

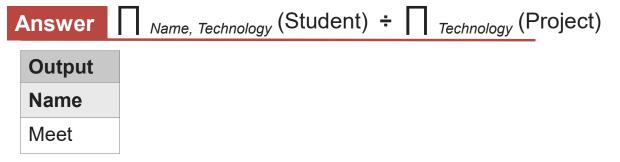
A		B1	B2	B3	B4
Sno	PNo	PNo	PNo	PNo	PNo
S1	P1	P2	P2	P1	P2
S1	P2		P4	P2	P5
S1	P3	-		P4	
S1	P4	Algebra (A)	÷ (B1) Algebra (A) ÷ (E	32) Algebra (A) ÷	(B3) Algebra (A) ÷ (B4
S2	P1				
S2	P2	Output	Output	Output	Output
S3	P2	SNo	SNo	SNo	SNo
		S1	S1	S1	
S4	P2	S2	S4		
S4	P4		34		
		S3			
S5	P4	0.4			

Division Operator Example

Example List the name of students doing a project in all technologies.

Stude	ent	
RNo	Name	Technology
101	Raj	.NET
101	Raj	PHP
102	Meet	.NET
102	Meet	PHP
102	Meet	iPhone
102	Meet	Android
103	Rohit	Android
104	Suresh	.NET
104	Suresh	iPhone
104	Suresh	Android

Proje	ect
TID	Technology
1	.NET
2	PHP
3	Android
4	iPhone





Relational Algebra Operations Rename Operator



Rename Operator

- Symbol: ρ (Rho)
- Notation: ρ_{A (X1,X2...Xn)} (Relation)
- Operation:
 - The rename operation is used to **rename the output relation**.
 - The result of rename operator are also relations with new name.
 - The original relation name can not be changed when we perform rename operation on any relation.
- · How to use:
 - ρ_x(E)
 Returns a relation E under a new name X.
 - ρ_{A1, A2...,An} (E)
 Returns a relation E with the attributes renamed to A1, A2, ..., An.
 - ρ_{x(A1, A2...,An)}(E)
 Returns a relation E under a new name X with the attributes renamed to A1, A2,, An.
- Reasons to rename a relation can be many, like –
- We may want to save the result of a relational algebra expression as a relation so that we can use it later.
- We may want to join a relation with itself, in that case, it becomes too confusing to specify which one of the tables we are talking about, in that case, we rename one of the tables and perform join operations on them.

Example Rename table

Stı	ıd	Δn	1

RNo	Name	СРІ
101	Raj	8
102	Meet	9
103	Jay	7

Algebra ρ_{Person} (Student)

Person

RNo	Nam	e	СРІ	
101	Raj		8	
102	Mee	t	9	
103	Jay		7	

Example Rename attributes

Student

Rno	Name	СРІ
101	Raj	8
102	Meet	9
103	Jay	7

Algebra

 $\rho_{(RollNo, StudentName, SPI)}$ (Student)

Student

RollNo	StudentName	SPI	
101	Raj	8	
102	Meet	9	
103	Jay	7	

Example Rename table and attributes both Example Rename particular attributes

Student			
Rno	Name	СРІ	
101	Raj	8	
102	Meet	9	
103	Jay	7	

Student		
Rno	Name	CPI
101	Raj	8
102	Meet	9
103	Jay	7

Algebra $\rho_{Person (RollNo, StudentName)} (\prod_{RNo, Name} (Student))$

Algebra P_{StudentName / Name} (Student)

Person	
RollNo	StudentName
101	Raj
102	Meet
103	Jay

Stude	ent	
Rno	StudentName	СРІ
101	Raj	8
102	Meet	9
103	Jay	7

Example Find out maximum CPI from student table.

Student

Rno	Name	СРІ
101	Raj	8
102	Meet	9
103	Jay	7

Step-2 $\sigma_{A.CPI < B.CPI}$ (ρ_A (Student) χ ρ_B (Student))

Output-2

A.Rno	A.Name	A.CPI	B.Rno	B.Name	B.CPI
101	Raj	8	102	Meet	9
103	Jay	7	101	Raj	8
103	Jay	7	102	Meet	9

Step-1 ρ_A (Student) $X \rho_B$ (Student)

Output-1

A.Rno	A.Name	A.CPI	B.Rno	B.Name	B.CPI
101	Raj	8	101	Raj	8
101	Raj	8	102	Meet	9
101	Raj	8	103	Jay	7
102	Meet	9	101	Raj	8
102	Meet	9	102	Meet	9
102	Meet	9	103	Jay	7
103	Jay	7	101	Raj	8
103	Jay	7	102	Meet	9
103	Jay	7	103	Jay	7

Example Find out maximum CPI from student table.

Stude	ent	
Rno	Name	СРІ
101	Raj	8
102	Meet	9
103	Jav	7

Step-3
$$\prod_{A.CPI} (\sigma_{A.CPI < B.CPI} (\rho_A (Student) \times \rho_B (Student)))$$
Output-

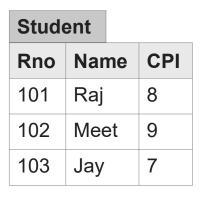
OutputA.CPI
8
7

Step-2 $\sigma_{A.CPI < B.CPI}$ (ρ_A (Student) χ ρ_B (Student))

Output-

A.Rno	A.Name	A.CPI	B.Rno	B.Name	B.CPI
101	Raj	8	102	Meet	9
103	Jay	7	101	Raj	8
103	Jay	7	102	Meet	9

Example Find out maximum CPI from student table.





OutputA.CPI
8
7

Step-4
$$\prod_{CPI} (Student) = \prod_{A.CPI} (\sigma_{A.CPI < B.CPI} (\rho_A (Student) \times \rho_B (Student)))$$

Stude	-	Output-	_	Output
СРІ		A.CPI		СРІ
8	_	8	=	9
9		7		
7			1	



Relational Algebra Operations Aggregate Functions



Aggregate Functions

- Symbol: g or G
- Notation: $g_{function-name(column), function-name(column), ..., function-name(column)}$ (Relation)
- Operation:
 - It takes a more than one value as input and returns a single value as output (result).
- Aggregate functions are:
 - Sum (It returns the sum (addition) of the values of a column.)
 - Max (It returns the maximum value for a column.)
 - Min (It returns the minimum value for a column.)
 - Avg (It returns the average of the values for a column.)
 - Count (It returns total number of values in a given column.)

Aggregate Functions Example

Stude	ent							
		D 1			Example	Find out sum of CPI of all students.	Outpu	t
Rno	Name	Branch	Semester	CPI			sum	
101	Ramesh	CE	3	9	Answer	$g_{sum(CPI)}$ (Student)	73	
102	Mahesh	EC	3	8				
103	Suresh	ME	4	7	Example	Find out maximum & minimum CPI.	Outpu	t
104	Amit	EE	4	8	Angwor	(Student)	max	min
105	Anita	CE	4	8	Allswei	$g_{max(CPI), min(CPI)}$ (Student)	9	7
106	Reeta	ME	3	7	Example	Count the number of students.	Outpu	t
107	Rohit	EE	4	9		a (0) 1 ()	count	
108	Chetan	CE	3	8	Answer	$g_{count(Rno)}$ (Student)	9	
109	Rakesh	CE	4	9	Example	Find out average of CPI of all students.	Outpu	t
							avg	
					Answer	$g_{avg(CPI)}$ (Student)	8.11	
							0.11	

Relational Algebra [Exercise]

- Write down relational algebras for the following table:
 - Employee (person-name, street, city)
 - Works (person-name, company-name, salary)
 - Company (company-name, city)
 - Managers (person-name, manager-name)
 - Find the names of all employees who work for "TCS".
 - Find the names and cities of residence of all employees who work for "Infosys".
 - Find the names, street and city of residence of all employees who work for "ITC" and earn more than \$10,000 per annum.
 - Find the names of all employees in this database who live in the same city as the company for which they work.
 - Find the names of all employees working in "TCS" who earn more than 25000 and less than 40000.
 - Find the name of employee whose manager is "Ajay Patel" and salary is more than 50000.
 - Display the name of employee with street, city, company name, salary and manager name staying in "Rajkot" and working in "Ahmedabad".
 - Find maximum, minimum and average salary of all employee.
 - Find out the total number of employee.