

Fundamentals of Database Systems | (5th Edition)

Chapter 6, Problem 16E

Step-by-step solution

Step 1 of 10

The following symbols are used to write a relation algebra query:

Symbol	Operation
σ	SELECT
π	PROJECT
\bowtie	EQUI-JOIN
$*$	NATURAL JOIN
\Join	FUNCTION
\div	DIVISION
$-$	SET DIFFERENCE

a. Following is the query to find the names of all employees in department 5 who work on the project ProductX for more than 10 hours per week:

```
R1 ← (σFNAME = 'ProductX' (PROJECT))
R2 ← (R1) ⋈PNUMBER = PNO (WORKS_ON)
R3 ← (EMPLOYEE) *SSN=ESSN (σHOURS>10 (R2))
Result ← πFNAME, LNAME (σDNO=5 (R3))
```

Result of query:

LNAME	FNAME
Smith	John
English	Joyce

Explanation:

- R1 will give the details of the project whose Pname is 'ProductX'. The details of ProductX will be the output.
- R2 will check the table works_on for Pno=1. It will give Essn, Pno and hours of the project whose Pnumber is 1.
- R3 will give the employee details from EMPLOYEE table whose Ssn number is same as the Essn number of result R2. The details of the employee with Ssn 123456789 and 453453453 will be displayed.
- Result will display only the Fname and Lname of the output obtained from R3.

Comment

Step 2 of 10

b. Following is the query that displays the names of the employee whose first name and dependent first name is same:

```
R1 ← (EMPLOYEE) ⋈(SSN=ESSN) AND (FNAME=DEPENDENT_NAME) (DEPENDENT)
Result ← πFNAME, LNAME (R1)
```

Result of query: Empty

FNAME	LNAME

Explanation:

- R1 will retrieve the details of the employees whose SSN of EMPLOYEE table is same as the ESSN of DEPENDENT table and whose FNAME of EMPLOYEE table is same as the DEPENDENT_NAME of DEPENDENT table.
- Result will display only the Fname and Lname of the output obtained from R1.

Comment

Step 3 of 10

c. Following is the query that displays the names of the employees whose is supervised by Franklin Wong:

```
R1 ← πSSN (σFNAME = 'Franklin' AND LNAME = 'Wong' (EMPLOYEE))
R2 ← (EMPLOYEE) ⋈SUPERSSN = SSN (R1)
Result ← πFNAME, LNAME (R2)
```

Result of query:

FNAME	LNAME
John	Smith
Ramesh	Narayan
Joyce	English

Explanation:

- R1 will give the SSN of the employee in EMPLOYEE table whose FNAME = 'Franklin' and LNAME = 'Wong'. The output will be 333445555.
- R2 will give the details of the employees in EMPLOYEE table whose SUPERSSN=333445555.
- Result will display only the Fname and Lname of the output obtained from R2.

Comment

Step 4 of 10

d. Following is the query that displays the project name and total hours per week spent one each project:

```
R1 (PNO, TOT_HRS) ← πPNO, SUM HOURS (WORKS_ON)
Result ← πFNAME, TOT_HRS ((R1) ⋈PNO= PNUMBER (PROJECT))
```

Result of query:

PNAME	TOT_HRS
ProductX	52.5
ProductY	37.5
ProductZ	50.0
Computerization	55.0
Reorganization	25.0
NewBenefits	55.0

Explanation:

- R1 will give the PNO and sum of Hours from WORKS_ON table.
- Result will give the PNAME and total of Hours by performing a equijoin between WORKS_ON table and PROJECT table. A equijoin is performed by matching the PNO of WORKS_ON table with PNUMBER of PROJECT table.

Comment

Step 5 of 10

e. Following is the query that displays the names of the employees who work on every project:

```
R1 (PNO, SSN) ← πPNO, SSN (WORKS_ON)
R2 (PNO) ← πPNUMBER (PROJECT)
R3 ← πFNAME, LNAME (R1 * R2)
Result ← πFNAME, LNAME (EMPLOYEE * R3)
```

Result of query:

FNAME	LNAME

Explanation:

- R1 will output the PNO and SSN from WORKS_ON table.
- R2 will output the PNUMBER from PROJECT table.
- R3 will output the FNAME and LNAME after performing R1 * R2.
- Result will output the FNAME and LNAME after performing natural join on EMPLOYEE and R3.

Comment

Step 6 of 10

f. Following is the query that displays the names of the employees who do not work on any project:

```
R1 ← πSSN (EMPLOYEE)
R2 (SSN) ← πESSN (WORKS_ON)
R3 ← R1 - R2
Result ← πFNAME, LNAME (EMPLOYEE * R3)
```

Result of query:

FNAME	LNAME

Explanation:

- R1 will output the SSN of all employees from EMPLOYEE table.
- R2 will output the ESSN from WORKS_ON table.
- R3 will perform the difference of result obtained from R1 and R2.
- Result will output the FNAME and LNAME after performing natural join on EMPLOYEE and R3.

Comment

Step 7 of 10

g. Following is the query that displays department name and department's average salary:

```
R1 (DNUMBER, AVG_SAL) ← πDNO, AVG SALARY (EMPLOYEE)
Result ← πDNUMBER, AVG_SAL (R1 * DEPARTMENT)
```

Result of query:

DNUMBER	AVG SAL
Research	33250
Administration	31000
Headquarters	55000

Explanation:

- R1 will output the average salary of each department from EMPLOYEE table.
- Result will output the average salary of each department after performing the natural join of R1 and DEPARTMENT.

Comment

Step 8 of 10

h. Following is the query that displays average salary of female employees:

```
Result (AVG_F_SAL) ← πAVG SALARY (σSEX = 'F' (EMPLOYEE))
```

Result of query:

AVG_F_SAL
31000

Explanation:

- (σ_{SEX = 'F'} (EMPLOYEE)) will output the details of female employees.
- π_{AVG SALARY} will perform the average of Salary of result obtained from (σ_{SEX = 'F'} (EMPLOYEE)).

Comment

Step 9 of 10

i. Following is the query that displays names and addresses of employees who work on a project at Houston and whose department has no location Houston:

```
R1(SSN) ← πESSN ((WORKS_ON) ⋈PNO=PNUMBER (σLOCATION='Houston' (PROJECT)))
R2 (DNUMBER) ← πDNUMBER (σLOCATION='Houston' (DEPARTMENT))
R3 ← πSSN (EMPLOYEE) ⋈DNO=DNUMBER (R2)
R4 ← R1 - R3
Result ← πFNAME, LNAME, ADDRESS (EMPLOYEE * R4)
```

Result of query:

FNAME	LNAME	ADDRESS
Jennifer	Wallace	291 Berry, Bellaire, TX

Explanation:

- R1 will give the ESSNs from WORKS_ON table whose PROJECT location is in Houston. To know the Project location, PNUMBER of WORKS_ON table is equijoin with the PNO of WORKS_ON table.
- R2 will give the DNUMBER of departments that has no location in Houston.
- R3 will give the SSN from EMPLOYEE table whose DNO is equal to the DNUMBER obtained from R2.
- R4 will give the differences of R1 and R3.
- Result will output the FNAME, LNAME and ADDRESS after performing natural join on EMPLOYEE and R4.

Comment

Step 10 of 10

j. Following is the query that displays the last name of managers who have no dependents:

```
R1 (SSN) ← πMGRSSN (DEPARTMENT)
R2 (SSN) ← πESSN (DEPENDANT)
R3 ← R1 - R2
Result ← πFNAME, LNAME (EMPLOYEE * R3)
```

Result of query:

FNAME	LNAME
James	Borg

Explanation:

- R1 will give the MGRSSN from DEPARTMENT table.
- R2 will give the ESSN from DEPENDANT table.
- R3 will give the difference of R1 - R2.
- Result will output the FNAME and LNAME after performing natural join on EMPLOYEE and R3.

Comment

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Chapter 6, Solution 27E

In a tuple relational calculus, query with n tuple variables should be at least (n - 1) join conditions, and the second side, the Cartesian product with one of the range relations would be taken. This usually does not make sense.

[See solution](#)

Chapter 6, Solution 30E

(a) Tuple calculus expression followed by the domain calculus expression is

$\sigma_A = C(R(A, B, C))$

[See solution](#)