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Database Design - CS 6360.002 - Fall 2022 - HW2B

6.2. What is union compatibility? Why do the UNION, INTERSECTION, and DIFFERENCE operations require that the relations on which they are applied be union compatible?
The tables must have the same attribute characteristics, which indicates that the attributes and their domains must be compatible, in order to be used in a UNION. It is claimed that two or more tables are union-compatible if they all have the same amount of columns and the associated columns have the same or compatible domains.

Because all of these operations are set operations that are binary, they must be union compatible in order for us to perform a Union, Intersection, or Difference operation on two separate relations.

6.16. Specify the following queries on the COMPANY relational database schema shown in Figure 3.5, using the relational operators discussed in this chapter. Also, show the result of each query as it would apply to the database state in Figure 3.6.
a. Retrieve the names of all employees in department 5 who work more than 10 hours per week on the ProductX project.
b. List the names of all employees who have a dependent with the same first name as themselves.
d. For each project, list the project name and the total hours per week (by all employees) spent on that project.
e. Retrieve the names of all employees who work on every project.
f. Retrieve the names of all employees who do not work on any project.
g. For each department, retrieve the department name and the average salary of all employees working in that department.
i. Find the names and addresses of all employees who work on at least one project located in Houston but whose department has no location in Houston.
j. List the last names of all department managers who have no dependents.

(Please find the answers below) ↓

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a) $EMP\_Px \leftarrow \sigma_{PNAME = 'Product\ x'}(PROJECT) \bowtie_{PNUMBER = PNO} (WORKS\_ON)$

$EMP\_TEN \leftarrow (EMPLOYEE) \bowtie_{SSN = ESSN} (\sigma_{HOURS > 10}(EMP\_Px))$

$RES \leftarrow \Pi_{FNAME, LNAME}(\sigma_{DNO=5}(EMP\_TEN))$

Result:

FNAME	LNAME
John	Smith
Joyce	English

b) $EMP \leftarrow (EMPLOYEE) \bowtie_{SSN = ESSN\ AND\ FNAME = DEPENDENT\_NAME} (DEPENDENT)$

$RES \leftarrow \Pi_{FNAME, LNAME}(EMP)$

Result: Empty

FNAME	LNAME

d) $PROJ\_HOURS(PNO, Total\_hours) \leftarrow {}_{PNO}F_{SUM HOURS}(WORKS\_ON)$

$RES \leftarrow \Pi_{PNAME, Total\_hours}(PROJ\_HOURS \bowtie_{PNO = PNUMBER} PROJECT)$

Result:

PNAME	Total_Hours
Product X	52.5
Product Y	37.5
Product Z	50.0
Computerization	55.0
Reorganization	25.0
New Benefits	55.0

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e) $PEMP(PNO, SSN) \leftarrow \Pi_{PNO, ESSN}(WORKS\_ON)$

$PRJS(PNO) \leftarrow \Pi_{PNUMBER}(PROJECT)$

$EMP\_PROJS \leftarrow PEMP \div PRJS$

$RES \leftarrow \Pi_{FNAME, LNAME}(EMPLOYEE * EMP\_PROJS)$

Result: Empty

FNAME	LNAME

f) $EMP\_PROJ(SSN) \leftarrow \Pi_{ESSN}(WORKS\_ON)$

$EMP\_PN \leftarrow EMP\_PROJ * EMPLOYEE$

$RES \leftarrow \Pi_{FNAME, LNAME}(EMPLOYEES - EMP\_PN)$

Result: Empty

FNAME	LNAME

g) $DAVG\_SAL(DNUMBER, AVG\_SAL) \leftarrow {}_{DNO}F_{AVG\ SALARY}(EMPLOYEE)$

$RES \leftarrow \Pi_{DNAME, AVG\_SAL}(DAVG\_SAL * DEPARTMENT)$

Result:

DNAME	AVG_SAL
Research	33250
Administration	31000
Headquaters	55000

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i) $A(SSN) \leftarrow \Pi_{ESSN}(WORKS\_ON \bowtie_{PNO = PNUMBER} (\sigma_{PLOCATION = 'HOUSTON'}(PROJECT)))$

$DHOU \leftarrow \Pi_{DNUMBER}(DEPARTMENT) - \Pi_{DNUMBER}(\sigma_{DLOCATION = 'HOUSTON'}(DEPARTMENT))$

$EDN \leftarrow \Pi_{SSN}(EMPLOYEE \bowtie_{PNO = DNUMBER} (DHOU))$

$RESD \leftarrow A - EDN$

$RESULT \leftarrow \Pi_{FNAME, LNAME, ADDRESS}(EMPLOYEE * RESD)$

Result:

FNAME	LNAME	ADDRESS
Jennifer	Wallace	291 Berry, Bellaire, Tx.

j) $DEPT\_MGR(SSN) \leftarrow \Pi_{MGRSSN}(DEPARTMENT)$

$EMP\_DEP(SSN) \leftarrow \Pi_{ESSN}(DEPENDENT)$

$RES \leftarrow \Pi_{LNAME}(EMPLOYEE * (DEPT\_MGR - EMP\_DEP))$

Result:

LNAME
Borg