CS 143 Homework 1

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Problem 1

Compute $(R - S) \cup (S - R)$**.**

This is the set of tuples that are present in R but not S *or* are present in S, but not R.

$$(R - S) = \{(7, 5, 3), (1, 4, 3), (6, 7, 9)\}$$

$$(S - R) = \{(1, 4, 4), (8, 3, 2)\}$$

$$\boxed{(R - S) \cup (S - R) = \{(7, 5, 3), (1, 4, 3), (6, 7, 9), (1, 4, 4), (8, 3, 2)\}}$$

Problem 2

Compute $\sigma_{R.L > S.M \wedge R.M < S.P}(R \times S)$.

This is the set of tuples in the Cartesian product of R and S that satisfy the condition that $R.L$ is greater than $S.M$ *and* $R.M$ is less than $S.P$.

$$\{R.L, R.M, S.M, S.N, S.P\}$$

$$(R \times S) = \{(4,3,6,1,8),(4,3,1,6,4),(4,3,2,5,1),(4,3,3,4,7),(6,5,6,1,8),(6,5,1,6,4),$$
$$(6,5,2,5,1),(6,5,3,4,7),(8,7,6,1,8),(8,7,1,6,4),(8,7,2,5,1),(8,7,3,4,7)\}$$

$$\sigma_{R.L > S.M} = \{(4,3,1,6,4),(4,3,2,5,1),(4,3,3,4,7),(6,5,1,6,4),(6,5,2,5,1),(6,5,3,4,7),$$
$$(8,7,6,1,8),(8,7,1,6,4),(8,7,2,5,1),(8,7,3,4,7)\}$$

$$\sigma_{R.M < S.P} = \{(4,3,6,1,8),(4,3,1,6,4),(4,3,3,4,7),(6,5,6,1,8),(6,5,3,4,7),(8,7,6,1,8)\}$$

$$\boxed{\sigma_{R.L > S.M \wedge R.M < S.P}(R \times S) = \{(4,3,1,6,4),(4,3,3,4,7),(6,5,3,4,7),(8,7,6,1,8)\}}$$

Problem 3

Student(student-name, department)

Course(course-name, department)

Enrollment(student-name, course-name)

a) Find the names of all students who are not enrolled in the 'Database Management Course'.

$$\Pi_{\text{student-name}}(\text{Enrollment} - \sigma_{\text{course-name} = \text{'DatabaseManagementCourse'}}(\text{Enrollment}))$$

b) Find the names of all students who are enrolled in at least one course not offered by their home department.

$$\Pi_{\text{student-name}}(\sigma_{\text{Student.student-name} = \text{Enrollment.student-name} \wedge \text{Student.department} \neq \text{Course.department}}(\text{Student} \times (\text{Course} \bowtie \text{Enrollment})))$$

c) Find the names of all courses which have no students enrolled.

$$\Pi_{\text{course-name}}(\text{Course}) - \Pi_{\text{course-name}}(\text{Course} \bowtie \text{Enrollment})$$

d) Find the department names that students belong to if the students take at least one class offered by the CS department.

$$\Pi_{\text{department}}(\text{Student} \bowtie (\text{Enrollment} \bowtie \sigma_{\text{department} = \text{'CS'}}(\text{Course})))$$

e) Find the department names of all students who are enrolled in at most one course.

$$\Pi_{\text{department}}(\text{Student} \bowtie (\Pi_{\text{student-name}}(\text{Student}) - \Pi_{\text{E1.student-name}}(\sigma_{\text{E1.student-name} = \text{E2.student-name} \wedge \text{E1.course-name} \neq \text{E2.course-name}}(\rho_{\text{E1}}(\text{Enrollment}) \times \rho_{\text{E2}}(\text{Enrollment})))))$$

Problem 4

Company(company-name, valuation)

Write a relational algebra expression to find the name of the lowest-valued companies.

$$\Pi_{\text{company-name}}(\text{Company} \bowtie (\Pi_{\text{valuation}}(\text{Company}) -$$
$$\Pi_{\text{Company.valuation}}(\sigma_{\text{Company.valuation} > \text{Company2.valuation}}(\text{Company} \times \rho_{\text{Company2}}(\text{Company})))))$$