Mandatory Exercise 1

IN3020&IN4020 (2022)

Deadline: 21 February 2022, 23:59 (Devilry)

Question 1.

Consider the following relations:

MathStudents:

SID	SName	Age
1	Peter	40
2	Peter	20
3	Anna	20

CSStudents:

SID	SName	Age
1	Julia	30
2	Peter	20

Takes:

SID	Course
1	Databases
2	Astronomy
2	Databases

Part a.

Evaluate the following (set) RA expression over these relations:

$$\pi_{\mathsf{SName,Course}}(\sigma_{\mathsf{Age}\geq 30 \vee \mathsf{SName}=\text{`Peter'}}(\mathsf{MathStudents} \cup \mathsf{CSStudents}) \bowtie \mathsf{Takes}).$$

Part b.

Evaluate the following (bag) RA expression over these relations[1]:

$$\gamma_{\mathsf{COUNT(SID),SName}}((\mathsf{MathStudents} \cup^{\mathsf{b}} \delta(\mathsf{CSStudents})) \bowtie \pi^{\mathsf{b}}_{\mathsf{SID}}(\mathsf{Takes})).$$

Question 2.

Part a.

Can renaming be pushed through join and selection—that is, which of the following algebraic laws hold?

$$\rho_N(R \bowtie S) = \rho_N(R) \bowtie \rho_N(S) \qquad \rho_N(\sigma_C(R)) = \sigma_C(\rho_N(R))$$

In each case, support your answer by an example (i.e., give relations and parameters so that the expressions on the two sides of $=$ are equal or non-equal). If your answer is no, additionally impose restrictions on the parameters (i.e., N and C) so that the law holds.

Part b.

Is right semi-join associative? Commutative? Idempotent? Support your answers by examples as in Part a.

Question 3.

Show that left outer join is expressible via union, difference, selection, generalised projection, and natural join (i.e., the core RA+generalised projection).

[1] Correction: formally, '$\mathsf{COUNT(SID)}$' should be $\mathsf{COUNT(SID)} \to \mathsf{CountSID}$'.