

Introduction to Databases

Relational Calculus

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(v26.0)

CHANGELOG

v26.0 Initial version.

Problem 1. Consider a schema consisting of a ternary relation R and a binary relation S , and let D be the database (instance) such that:

$$R^D = \{(1, 1, 2), (1, 0, 0), (1, 2, 2), (1, 1, 0), (1, 2, 3), (2, 2, 3)\}$$
$$S^D = \{(0, 0), (2, 1), (1, 3), (1, 2)\}$$

Compute the answer to each of the following queries on D under active domain semantics:

$$Q_1 = \{x \mid \exists y, z \ R(y, z, x) \wedge z \neq y \wedge S(x, x)\}$$

$$Q_2 = \{x, y \mid \forall z \ R(x, z, y) \rightarrow (S(x, z) \vee S(y, z))\}$$

$$Q_3 = \{z \mid \neg \exists y \ S(y, z) \wedge S(z, y)\}$$

Justify your answers appropriately.

Problem 2. Given a schema consisting of a binary relation R and a ternary relation S , write a relational calculus query that computes the active domain.

Problem 3. Consider the following schema:

CUSTOMER($\cdot, \cdot, \cdot$) of arity 3, where the first position is the customer's *ID*, the second is the customer's *Name*, and the third is the *City* where the customer lives.

ACCOUNT ($\cdot, \cdot, \cdot, \cdot$) of arity 4, in which the first position is the account's *Number*, the second is its *Branch*, the third is the ID of the customer owning the account, and the fourth is the *Balance* on the account.

Write the following queries in relational calculus (directly, without translating from relational algebra):

- (1) "ID and name of customers who own an account in a branch in their city."
- (2) "ID and name of customers who do **not** own any account."
- (3) "ID and name of customers who own an account with a balance which is no less than the balance of any other account."