Introduction to Databases
Translations between RA and RC

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Problem 1. Consider the schema with tables Customer over attributes *ID*, *Name*, *City* (in this order) and Account over attributes *Number*, *Branch*, *CustID*, *Balance* (in this order). Express the following relational algebra query in relational calculus:

$$\textsc{Customer} \bowtie \big(\pi_{\text{ID,City}}(\textsc{Customer}) \cap \rho_{\text{CustID}\to\text{ID},\ \text{Branch}\to\text{City}}\big(\pi_{\text{Branch,CustID}}(\textsc{Account})\big)\big) \tag{1}$$

Use the translation rules from RA to RC we have seen in class.

Problem 2. Given a relation R over attribute A, and a relation S over attributes A, B (in this order), translate the following relation calculus query to relational algebra:

$$\{\, x, z \mid R(x) \wedge \neg\exists y\ S(y, z) \,\}$$

Problem 3. Given two relations R and S, each over attributes A, B (in this order), express the following relational calculus query in relational algebra:

$$\big\{x \mid \neg\big(\forall y\ R(x, y) \to S(x, y)\big) \wedge \neg\big(\exists z\ S(x, z) \wedge R(z, x)\big)\big\}$$

Use only the translation rules from RC to RA we have seen in class.

Problem 4.

(a) Can we simplify the relational algebra expression obtained in Problem 3 into an equivalent expression that does not mention the active domain? If yes, give such an expression. Otherwise, explain why this is the case.

(b) How would you translate the relational calculus query of Problem 3 if the output tuple (i.e., the head of the query) were x, x rather than x?