Weekly exercises IN3020&4020 (2025)
Week 3: Relational Algebra

1 Review

1. What is the domain of the Relational Algebra (i.e., what type of arguments take relational algebra operators)?
2. List the operations of the core relational algebra (our version of) and briefly state the purpose of each.
3. When is each of the core operations defined?
4. What is a commutative operation? Give an example of a commutative operation from relational algebra.
5. What is an associative operation? Give an example of an associate operation from relational algebra.
6. What is a unary idempotent operation? What is a binary idempotent operation? Give one example of each from relational algebra.

2 Relation algebra computations

Consider the following two relations:

R:

A	B
1	2
3	4
4	5

S:

C	D
1	2
3	5
3	6
4	5
5	6

Using our core Relational Algebra for sets extended with natural join compute the following:

1. $\pi_A(R)$
2. $\pi_B(S)$

3. $\pi_C(S)$
4. $\sigma_{A=1}(R)$
5. $R \bowtie S$
6. $(\rho_{B \to C}(R)) \bowtie S$
7. $\sigma_{D=5}(\rho_{A \to C}(R) \bowtie S)$

3 (*) Correctness of Relational Algebra expressions

Assuming the schemas in the previous section, which of the following expressions are valid (under our definitions) and which are not? Explain your answer.

1. $R \times R$
2. $R \cup (\rho_{C \to B, D \to A}(S))$
3. $\sigma_{A > \texttt{ALL}(\pi_D(S))}(R)$

4 Relation algebra expression

Consider four relations with the following schemas (the domains and the meaning of the attributes are as expected):

$Product\,[manufacturer, model, type]$
$PC\,[model, speed, RAM, HDD, price]$
$Laptop\,[model, speed, RAM, HDD, screen, price]$
$Printer\,[model, colour, type, price]$

Express the following queries as relational algebra expressions using relational algebra operators σ, π, $\times$, $\cup$, $\setminus$, $\cap$, ρ, and $\bowtie$.

1. The PC models that have speed at least 2.50.
2. The manufacturers that sell printers, but not PCs.
3. The manufacturers that make laptops with a HDD of at least 500 GB.
4. The model numbers and prices of all products made by manufacturer called HP.