Equivalent Notations in Relational Algebra, Tuple Relational Calculus, and Domain Relational Calculus

Select Operation

R = (A, B)

Relational Algebra: $\sigma_{B=17}\ (r)$

Tuple Calculus: $\{t \mid t \in r \land B = 17\}$

Domain Calculus: $\{<a, b> \mid <a, b> \in r \land b = 17\}$

Project Operation

R = (A, B)

Relational Algebra: $\pi_{A}(r)$

Tuple Calculus: $\{t \mid \exists\ p \in r\ (t[A] = p[A])\}$

Domain Calculus: $\{<a> \mid \exists\ b\ (\ <a, b> \in\ r\ )\}$

Combining Operations

R = (A, B)

Relational Algebra: $\pi_{A}(\sigma_{B=17}\ (r))$

Tuple Calculus: $\{t \mid \exists\ p \in r\ (t[A] = p[A] \land p[B] = 17)\}$

Domain Calculus: $\{<a> \mid \exists\ b\ (\ <a, b> \in\ r \land\ b = 17)\}$

Natural Join

R = (A, B, C, D)   S = (B, D, E)

Relational Algebra: $r \bowtie s$

$\pi_{r.A,r.B,r.C,r.D,s.E}(\sigma_{\text{r.B=s.B} \wedge \text{r.D=s.D}}\ (r \times s))$

Tuple Calculus: $\{t \mid \exists\ p \in r\ \exists\ q \in s\ (t[A] = p[A] \wedge t[B] = p[B] \wedge t[C] = p[C] \wedge t[D] = p[D] \wedge t[E] = q[E] \wedge p[B] = q[B] \wedge p[D] = q[D])\}$

Domain Calculus: $\{\langle a, b, c, d, e\rangle \mid \langle a, b, c, d\rangle \in r \wedge \langle b, d, e\rangle \in s\}$

Union

R = (A, B, C)   S = (A, B, C)

Relational Algebra: $r \cup s$

Tuple Calculus: $\{t \mid t \in r \vee t \in s\}$

Domain Calculus: $\{\langle a, b, c\rangle \mid \langle a, b, c\rangle \in r \vee \langle a, b, c\rangle \in s\}$

Intersection

R = (A, B, C) S = (A, B, C)

Relational Algebra: $r \cap s$

Tuple Calculus: $\{t \mid t \in r \wedge t \in s\}$

Domain Calculus: $\{\langle a, b, c\rangle \mid \langle a, b, c\rangle \in r \wedge \langle a, b, c\rangle \in s\}$

Set Difference

R = (A, B, C) S = (A, B, C)

Relational Algebra: $r - s$

Tuple Calculus: $\{t \mid t \in r \wedge t \notin s\}$

Domain Calculus: $\{\langle a, b, c\rangle \mid \langle a, b, c\rangle \in r \wedge \langle a, b, c\rangle \notin s\}$

Cartesian/Cross Product

R = (A, B) S = (C, D)

Relational Algebra: $r \times s$

Tuple Calculus: $\{t \mid \exists\, p \in r\ \exists\, q \in s\ (t[A] = p[A] \wedge t[B] = p[B] \wedge$
$t[C] = q[C] \wedge t[D] = q[D])\}$

Domain Calculus: $\{\langle a, b, c, d\rangle \mid \langle a, b\rangle \in r \wedge \langle c, d\rangle \in s\}$

Division

R = (A, B)   S = (B)

Relational Algebra: $r \div s$

Tuple Calculus: $\{t \mid \exists\, p \in r\ \forall q \in s\ (p[B] = q[B] \Rightarrow t[A] = p[A])\}$

Domain Calculus: $\{<a> \mid <a> \in r \wedge \forall <b>\ (<b> \in s \Rightarrow <a, b> \in r)\}$

Use of the Universal Quantifier

salary = (employee, salary-amount)

To find the maximum salary-amount:

(Extended) Relational Algebra:

$max_{salary\text{-}amount}(salary)$

Tuple Calculus:

$\{t \mid \forall p \in salary \Rightarrow p[salary\text{-}amount] \leq t[salary\text{-}amount]\}$

Domain Calculus:

$\{<s> \mid \exists e(<e, s> \in salary \wedge \forall e1, s1(<e1, s1> \in salary \Rightarrow s1 \leq s))\}$