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                              A Crash Course in
Relational Algebra (RA), Domain Calculus (DC), Tuple Calculus (TC), and
 the Structured Query Language (SQL) through Three Easy Example Queries

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R(A:int,B:int), S(B:int,C:int)

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pi[A,R.B,C](sigma[R.B=S.B](R x S))                  -- implicit renaming

pi[A,R.B,C](sigma[R.B=S.B](delta[R.B<-B](R) x delta[S.B<-B](S)))

R * S                    -- notation also: R \bowtie S; roughly: R |><| S

{a,b,c | R(a,b) /\ S(b,c)}

{a,b,c | EX b2 (R(a,b) /\ S(b2,c) /\ b=b2)}

{a,b,c | EX d  (R(a,b) /\ S(d,c)  /\ b=d )}

{t:(A,B,C) | EX r:R EX s:S
                        (t.A=r.A /\ t.B=r.B /\ t.C=s.C /\ r.B=s.B)}

{t:(A,B,C) | EX r:(A,B) EX s:(B,C) (R(r) /\ S(s) /\
                         t.A=r.A /\ t.B=r.B /\ t.C=s.C /\ r.B=s.B)}

{t:(A,B,C) | EX r:(W,X) EX s:(Y,Z) (R(r) /\ S(s) /\
                         t.A=r.W /\ t.B=r.X /\ t.C=s.Z /\ r.X=s.Y)}

select r.A, r.B, s.C
from   R r, S s
where  r.B=s.B

select A, R.B, C
from   R, S
where  R.B=S.B

select * from R natural inner join S           -- also: R natural join S

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R cup S

{x,y | R(x,y) \/ S(x,y)}

{t:(A,B) | R(t) \/ S(t)}

{t:(A,B) | (EX r:R t=r) \/ (EX s:S t=s)}

select * from R union select * from S -- parentheses (_)union(_) illegal

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R - pi[A1,B1](sigma[B1>B2](delta[A1,B1<-A,B](R) x delta[A2,B2<-A,B](R)))

{a,b | R(a,b) /\ AL a2,b2 (R(a2,b2) /\ a=a2 => b<=b2)}
          -- original DC and TC: only equality =; no comparison on size

{a,b | R(a,b) /\ AL b2 (R(a,b2) => b<=b2)}

{a,b | R(a,b) /\ AL b2 (~ R(a,b2) \/ b<=b2)}

{t:(A,B) |
      EX r1:R t.A=r1.A /\ t.B=r1.B /\ AL r2:R (r1.A=r2.A => r1.B<=r2.B)}

{t:(A,B) |
    EX r1:R t.A=r1.A /\ t.B=r1.B /\ AL r2:R (~ r1.A=r2.A \/ r1.B<=r2.B)}

select A, B
from   R r
where  B <= all (select B from R where A=r.A)

select   A, Min(B)
from     R
group by A

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RA: cup, x, -, pi, sigma, delta      -- 5 1/2 ops; 3 x binary, 3 x unary
    [union, product, minus, project, select, rename]

DC: domain variables x[:D], R(x,y), /\, \/, ~, EX, AL

TC: tuple variables t:(A,B), R(t), t:R, /\, \/, ~, EX, AL

SQL: SFW, and, or, not, in, any, all, exists                -- no forall

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