

Continue example from last week....

$$\begin{aligned}
 & \overline{F} \\
 & \overline{F \wedge (X_1 \dots X_n) \wedge \neg G(X_1 \dots X_m, Y_1 \dots Y_k)} \\
 \rightarrow & \overline{Q(F)} \quad m \leq n, k \geq 0 \\
 & Q(\overline{F}) \quad \Delta \quad ((E)^{m+k} - Q(G)) \\
 & \text{model size of } \Delta \quad \Delta \quad \text{large set - something} \\
 & \quad \quad \quad \Delta \quad \text{contains only matching answers} \\
 \text{result:} & \quad \pi[X_1 \dots X_n](Q(F)) \subseteq Q(\overline{F})
 \end{aligned}$$

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EX: names of all countries, pop > 1.000.000
and not member of the EU

$$F(N) = \exists C, G, CP, A, Pop: \text{country}(N, C, G, CP, A, Pop) \wedge Pop > 1.000.000$$

⇒ Algebra:

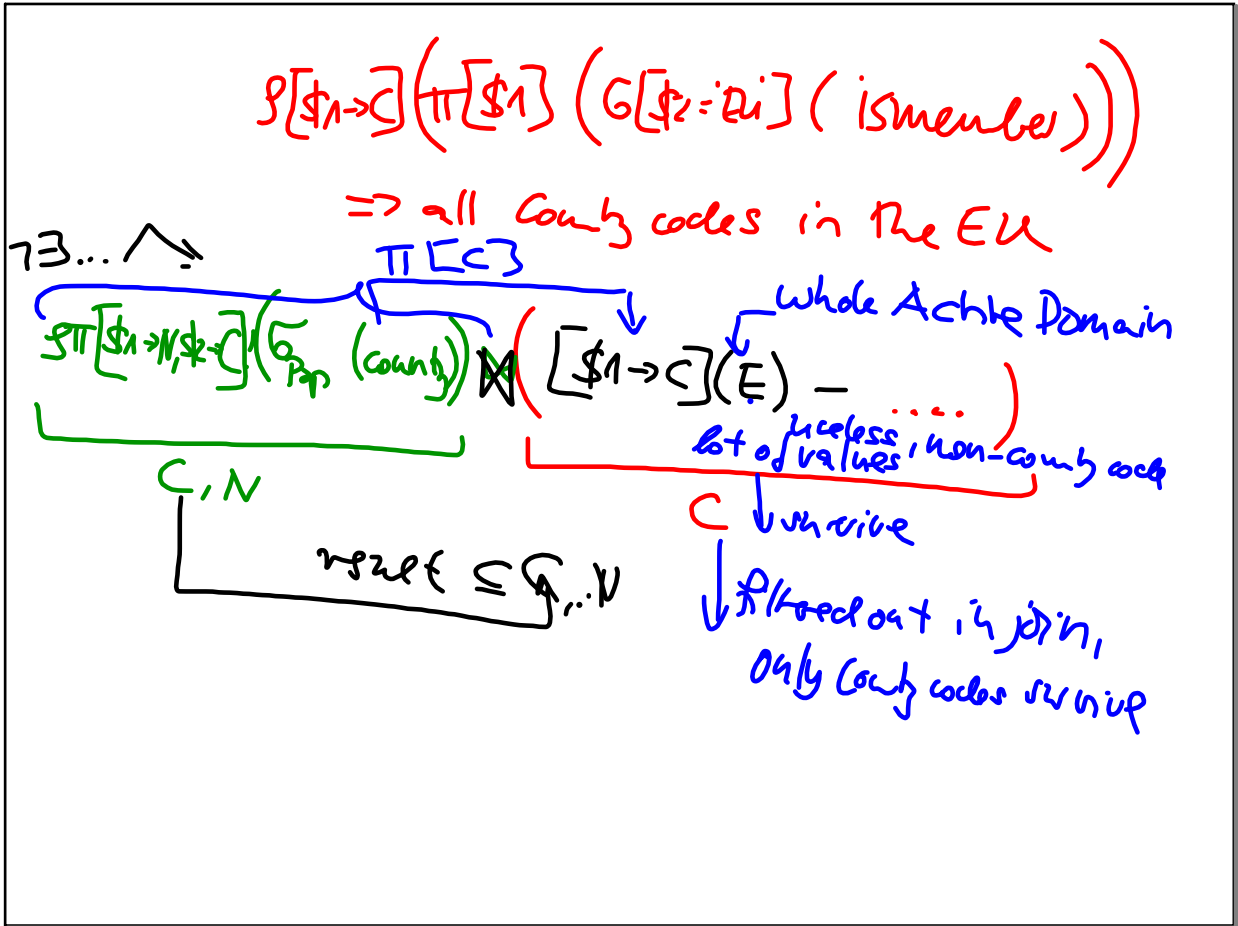
$$\exists [\$1 \rightarrow C, \$2 \rightarrow G] (\pi [\$1, \$3] (\exists [\$2 = 'EU'] (\text{ismember})))$$

$$= \exists [\$1 \rightarrow C] (\pi [\$1] (\exists [\$2 = 'EU'] (\text{ismember})))$$

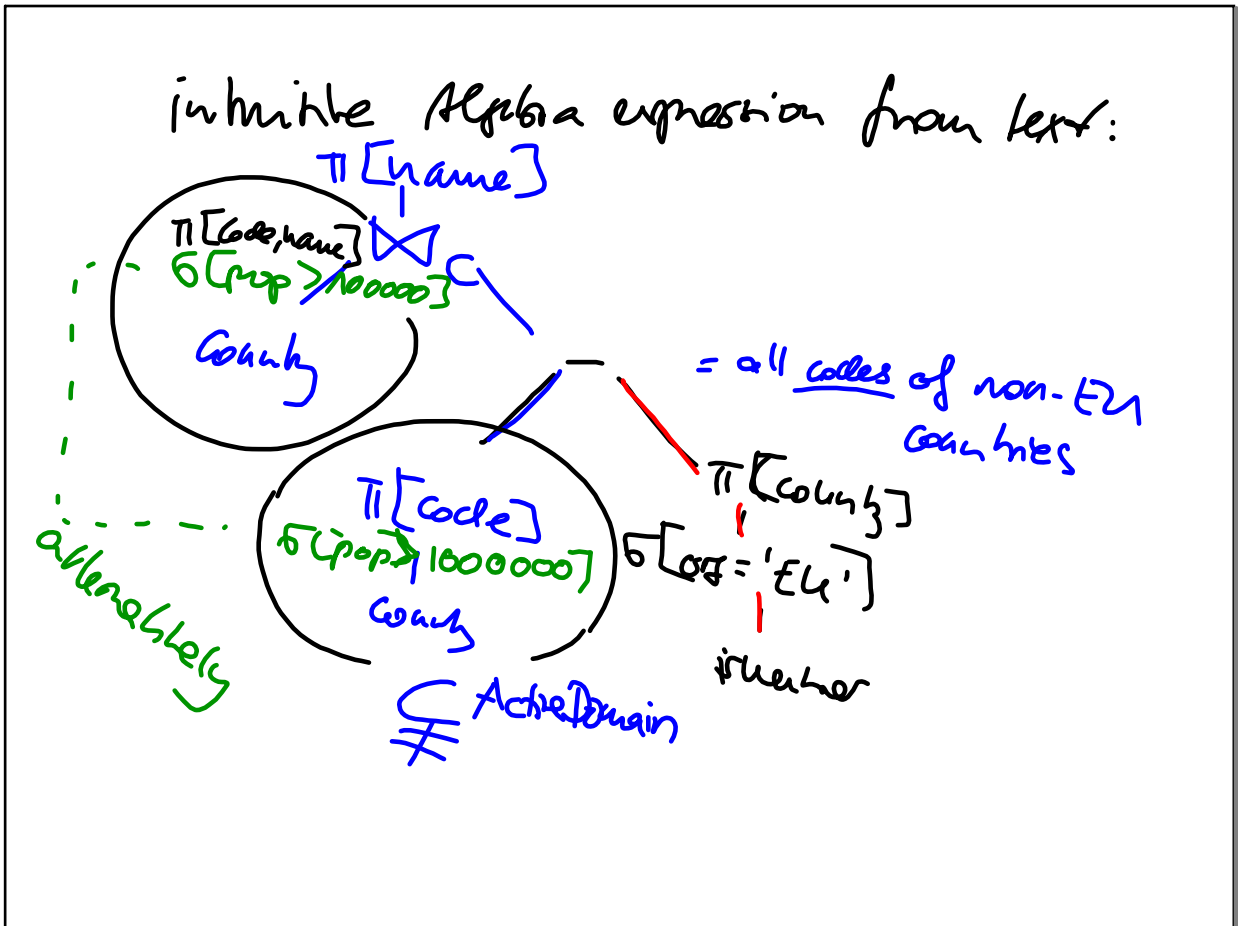
$$\exists [\$1 \rightarrow N, \$2 \rightarrow C, \$3 \rightarrow G] (\pi [\$1, \$2, \$3] (\text{country})) \wedge \exists [\$4 > 1000000]$$

⇒ all CN of countries with > 1000000

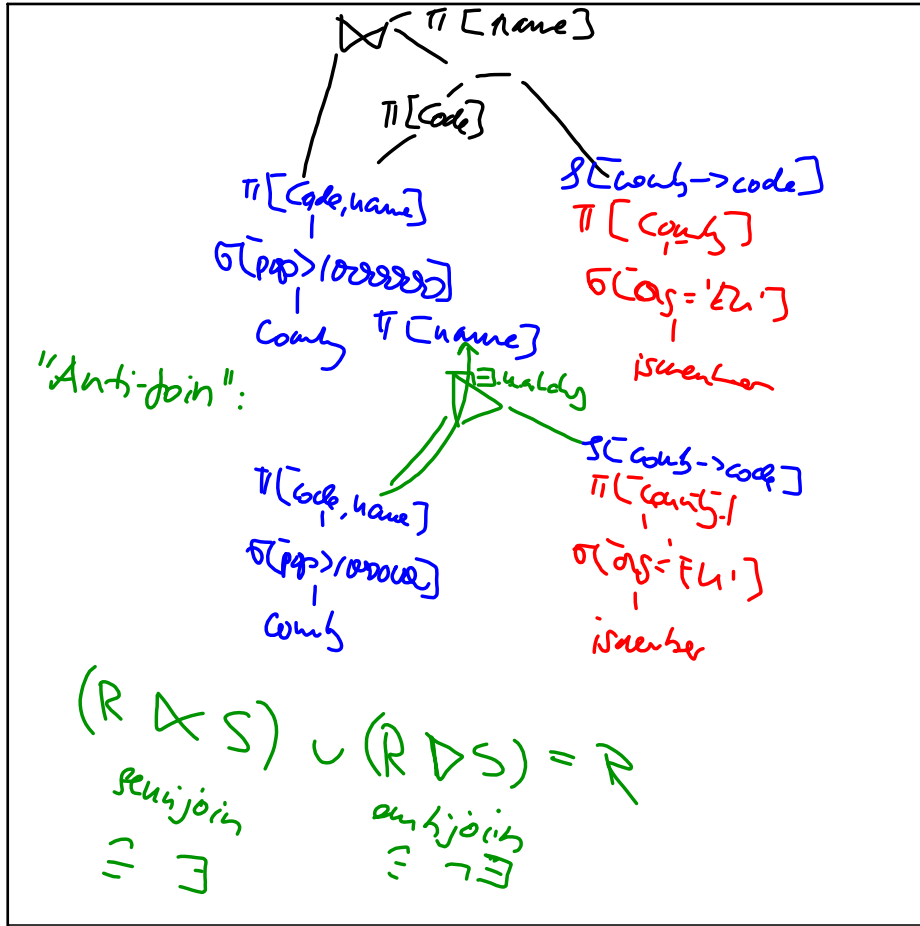
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Exercise 2 or 3 of sheet 1: $r = \{x, y\}$

a) $F(x, y, z) = p(x, y) \wedge (q(y) \vee r(z))$

DB state:

$\mathcal{D}(p) = \{(1, a)\}$

$\mathcal{D}(q) = \{a\}$

$\mathcal{D}(r) = \emptyset$

$\mathcal{D}(F) = \{x \rightarrow 1, y \rightarrow a, z \rightarrow d \in \emptyset\}$

\Rightarrow not domain-dependent

\Rightarrow not SRNF

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b) $F(x,y) = P(x,y) \wedge (q(y) \vee r(x))$

$r = \{x,y\}$ $r = \emptyset$

\Rightarrow SRNF

RANT: $q(y) \vee r(x)$

$r = \{y\} \rightarrow$ not in RANT

$\Rightarrow (P(x,y) \wedge q(y)) \vee (P(x,y) \wedge r(x))$

SQL

select P1, P2
from P
where P2 in (select R1 from R)
or P1 in (select R1 from R)

$\frac{P}{P1, P2}$ $\frac{R}{R1}$

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c) $F(x,y) = P(x,y) \wedge \exists z: r(y,z)$

$r = \{y,z\}$ $r = \emptyset$

select P1, P2
from P
where not P2 in (select R1 from R)

SRNF $\frac{P}{P1, P2}$ $\frac{R}{R1, R2}$

Relational Algebra

it is also in RANT

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d)

$$F(x) = p(x) \wedge \exists y : (q(y) \wedge \neg r(x,y))$$

$\pi = \{x\}$ (under $p(x)$)
 $\pi = \{y\}$ (under $q(y)$)
 $\pi = \{x, y\} \neq \text{free } \{x, y\}$ (under $\neg r(x,y)$)
 $\pi = \emptyset$ (under $\exists y$)

RANF? no SRNF ✓

Def. Normal Form:

$$F'(x) = \exists y : p(x) \wedge q(y) \wedge \neg r(x,y)$$

equal to $F(x)$ to

Abstr. tree inhibitory

```

    graph TD
      X[x] --- P[p]
      X --- Q[q]
      X --- R[r]
    
```

select * from P, Q where not (P, Q) in (select * from R)

(select * from P, Q) MINUS (select * from R)

Proof-construct

```

    graph TD
      X[x] --- Q[q]
      X --- P[p]
      X --- E2[E2]
      X --- R[r]
    
```

TOMORROW @)

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