

Predicate Symbols vs. function symbols

$$\Sigma = \Sigma_{pred} \cup \Sigma_{fct}$$

example:

$$\{ \overset{\text{hasfather}/2}{P/1, q/2} \} \cup \{ \overset{\text{with aries}}{\overset{\text{father}/1}{c/0, f/1, g/2}} \}$$

→ terms e.g.
 $c, f(c), g(1,2)$
 $\text{father}(\text{alice})$

→ atomic formulas
 $P(c)$
 $P(g(1,2))$
 $q(f(c), 1)$
 $\text{hasfather}(\text{alice}, \text{john})$

⇒ Interpretation of Logic Symbols

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$$\mathcal{I} = (I, \mathcal{D})$$

of fct symbols $\in \Sigma$ { alice, john, ... }
 and of pred symbols $\in \Sigma$

I of fct symbols

- $I(\text{alice}) = \text{alice}$
- $I(\text{john}) = \text{john}$
- $I(\text{father}) = \dots$ a mapping $\mathcal{D} \rightarrow \mathcal{D}$

Interpretation of pred. symbols

alice \mapsto john

$$I(\text{hasfather}/2) \subseteq \mathcal{D} \times \mathcal{D}$$

a mapping $\mathcal{D} \times \mathcal{D} \rightarrow \{T, F\}$

$$I(\text{hasfather}) = \{ (\text{alice}, \text{john}), \dots, (\text{john}, \text{jack}) \}$$

Interpretation of constants

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→ Herbrand "style"

interpretation of constant symbols

alice "means" alice
 john "means" john
 father(alice) "means" father(alice)

→ when working with that (PROLOG)
 ⇒ need equality, and assert

father(alice) = john
 ≙ same as
 → more expressive

⇒ Datalog does not have fct. symbols (except constants)

additional reason: DB has only relations = predicates
 ⇒ here we have hasfather/2
 if "first column is key"
 ⇒ hasfather is functional

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"5 persons named alice?"

↳ identification!

⇒ Person/1... is a unary predicate

→ five symbols for these persons
 P_1, P_2, P_3, P_4, P_5

• $I(Person) = \{P_1, P_2, P_3, P_4, P_5\}$

•

Person
P_1
\vdots
P_5

• Datalog:

person(P_1):
 person(P_2):
 person(P_3):
 person(P_4):
 person(P_5):

↳ symbols!

⇒ need predicate name/2

Person	name
P_1	"Alice"
P_2	"Alice"
\vdots	\vdots

$P_1 \neq P_2$

"Unique name Assumption"

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Exercise 1

a) $F(X, Y, Z) = \pi_{\{X, Y\}}(P(X, Y) \wedge (q(Y) \vee r(Z)))$

consider DB:

1	2
---	---

9
2

7

$(1, 2, ?) \leftarrow P(1, 2) \wedge (q(2) \vee r(Z))$

\rightarrow does not make sense

\rightarrow not safe

\rightarrow not domain-independent!

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b) $F(X, Y, Z) = \pi_{\{X, Y\}}(P(X, Y) \wedge (q(Y) \vee r(X)))$

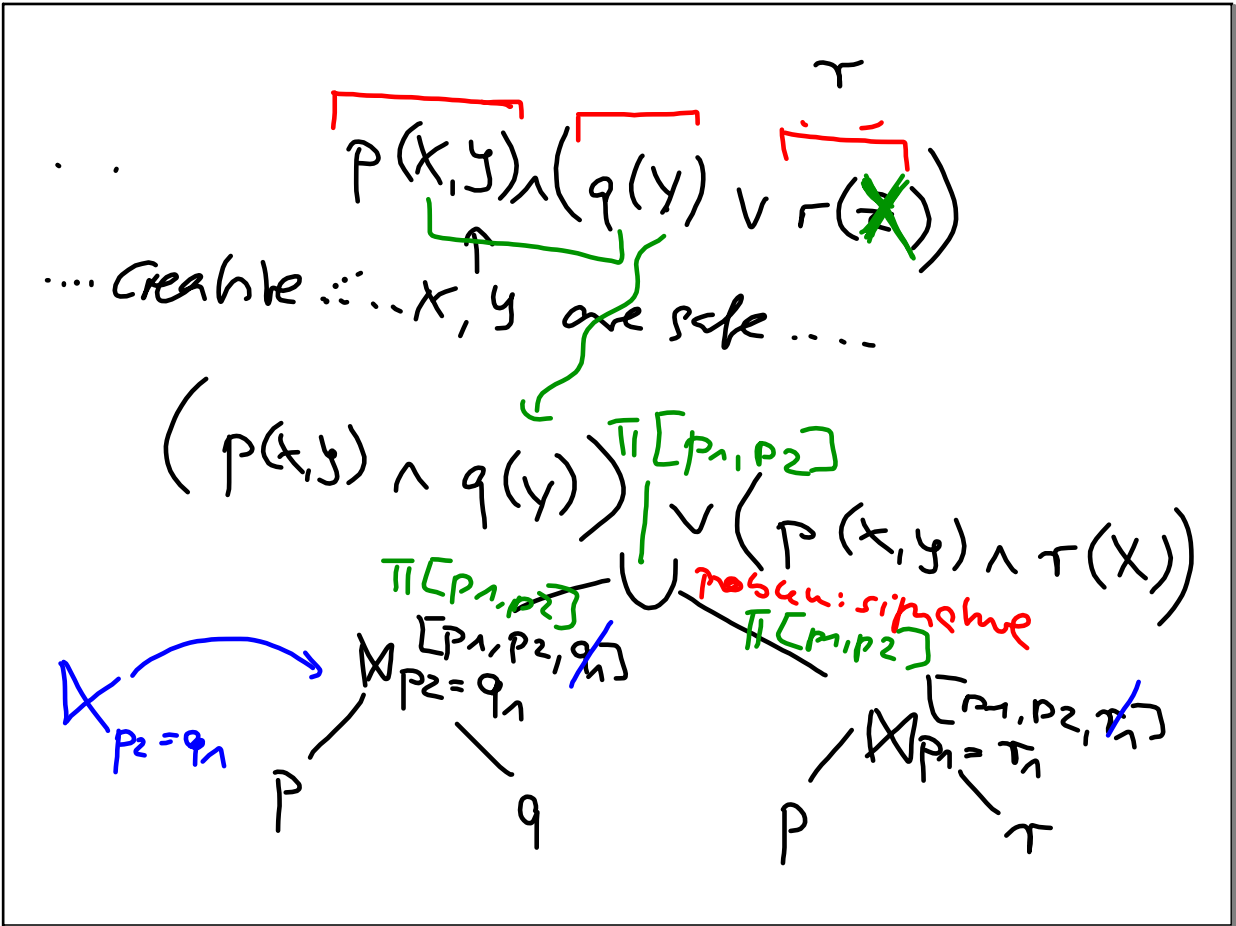
Safe ✓
algebra

$P(P_1, P_2)$
 $q(Q_1)$
 $r(R_1)$

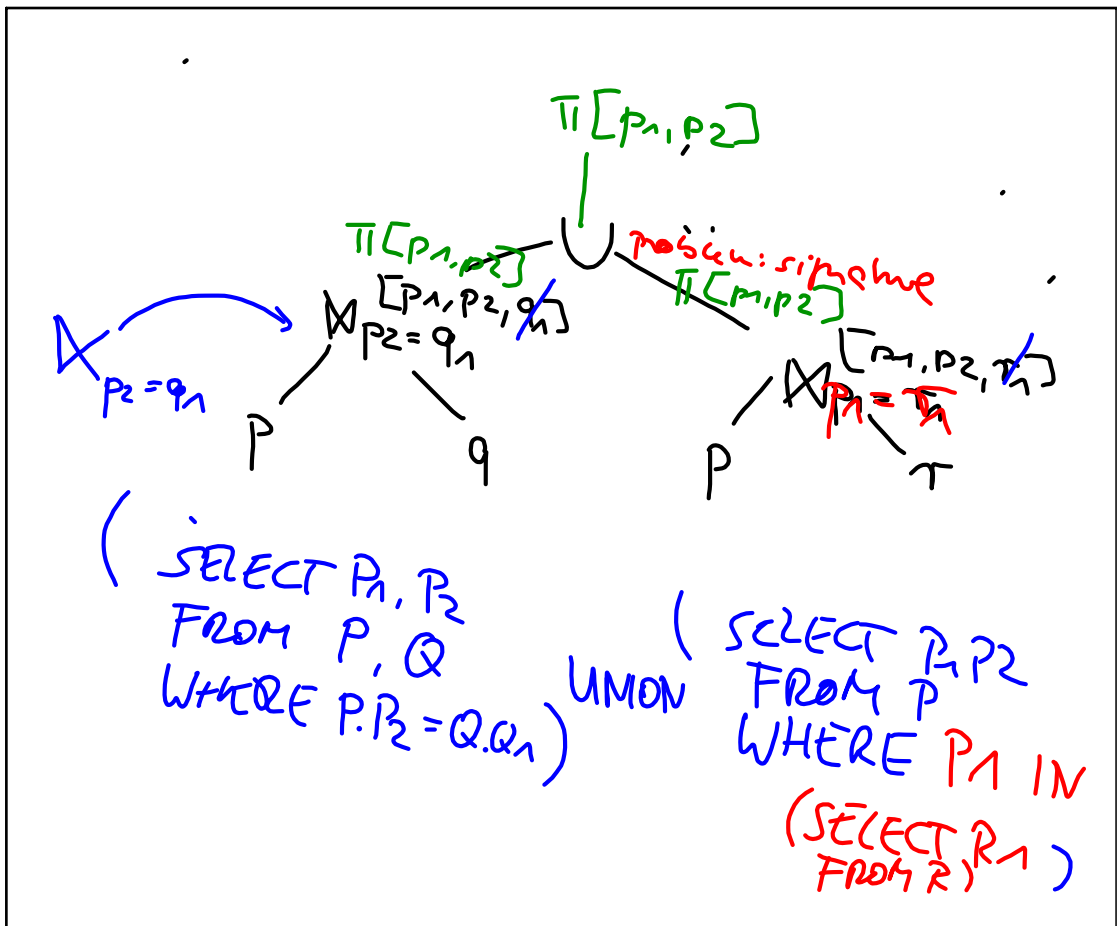
problem: signature!

$P(X, Y) \wedge (q(Y) \vee r(X))$

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Alternative in SQL :

$$F(x,y) = \underline{P(x,y)} \wedge (\underline{q(y)} \vee \underline{r(x)})$$

```

SELECT P1, P2
FROM P
WHERE XP2 IN (SELECT Q1 FROM Q)
OR XP1 IN (SELECT R1 FROM R)
    
```

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$$\underline{P(x,y)} \wedge (\underline{q(y)} \vee \underline{r(x)})$$

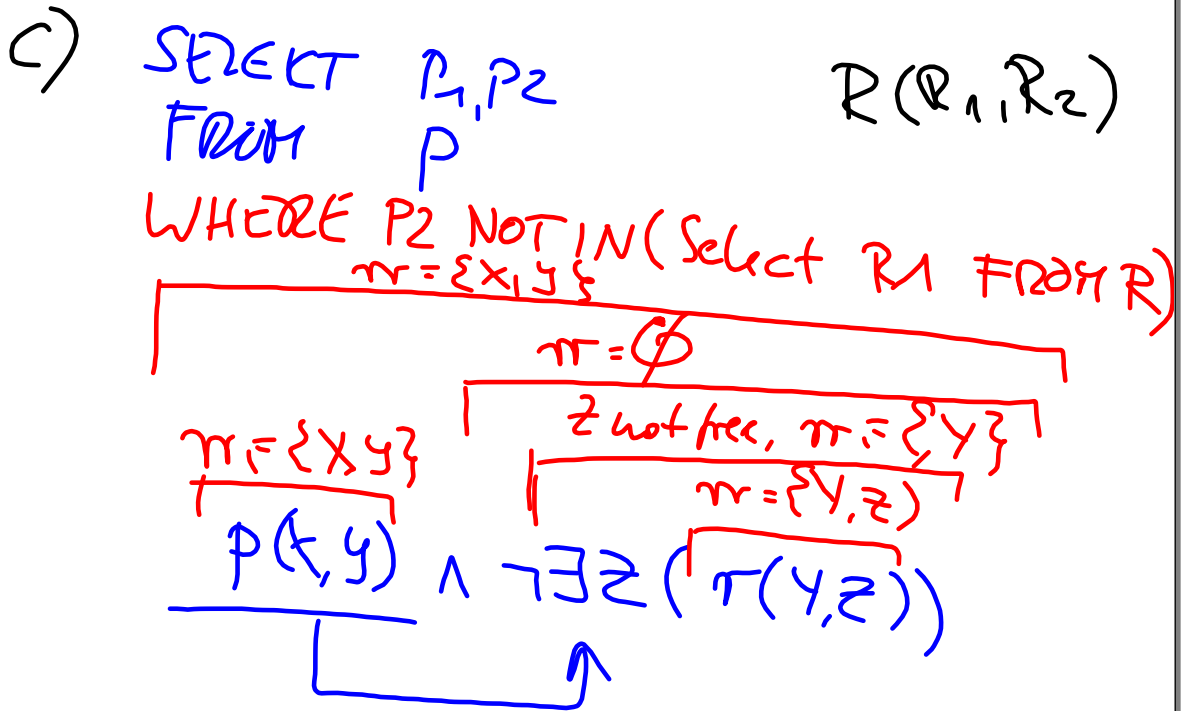
base / EDB relations P_2, q_1, r_1

result(x,y) :- P(x,y), v(x,y)

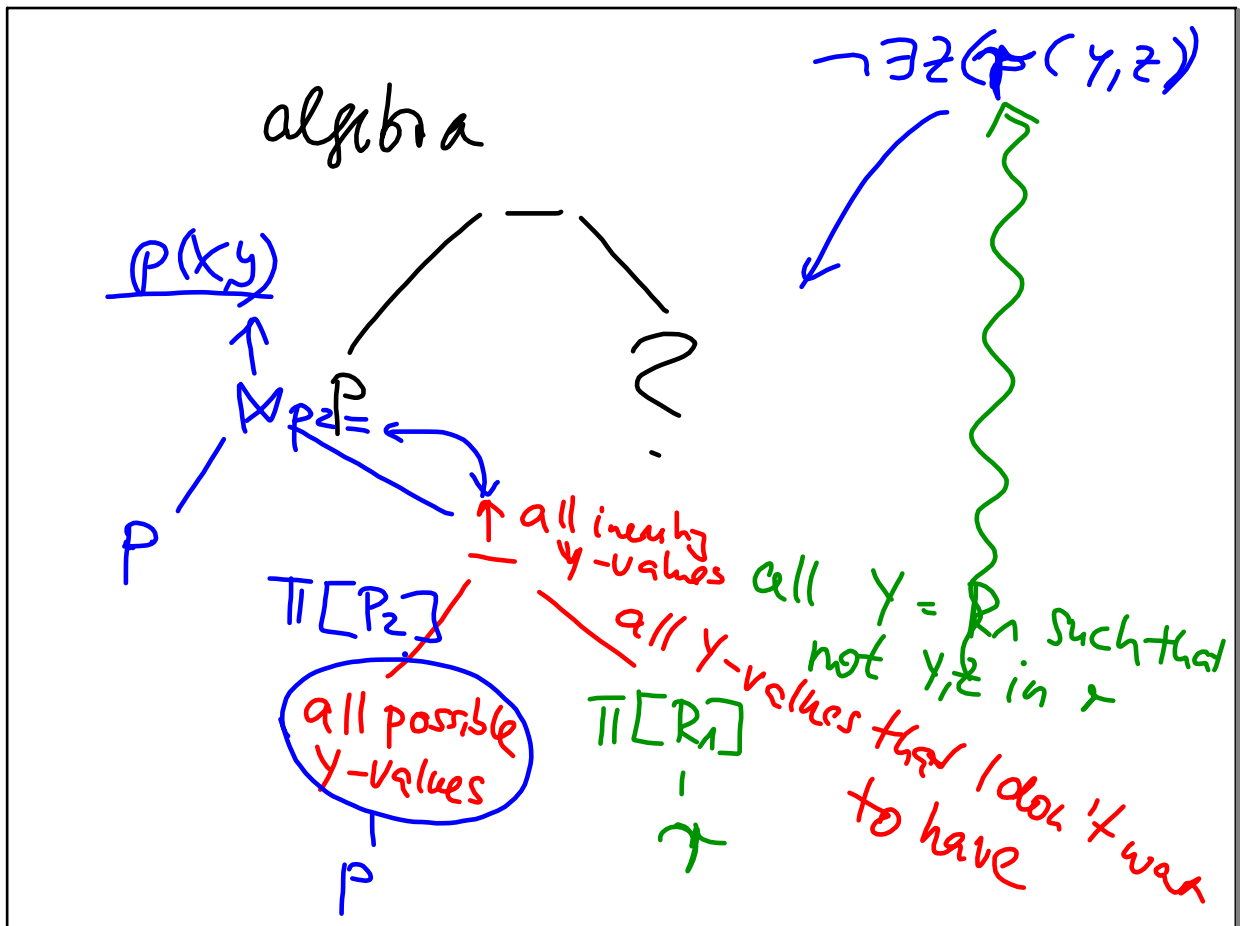
v(x,y) :- q(y), ~~ADOM(x)~~

v(x,y) :- r(x), ~~ADOM(y)~~

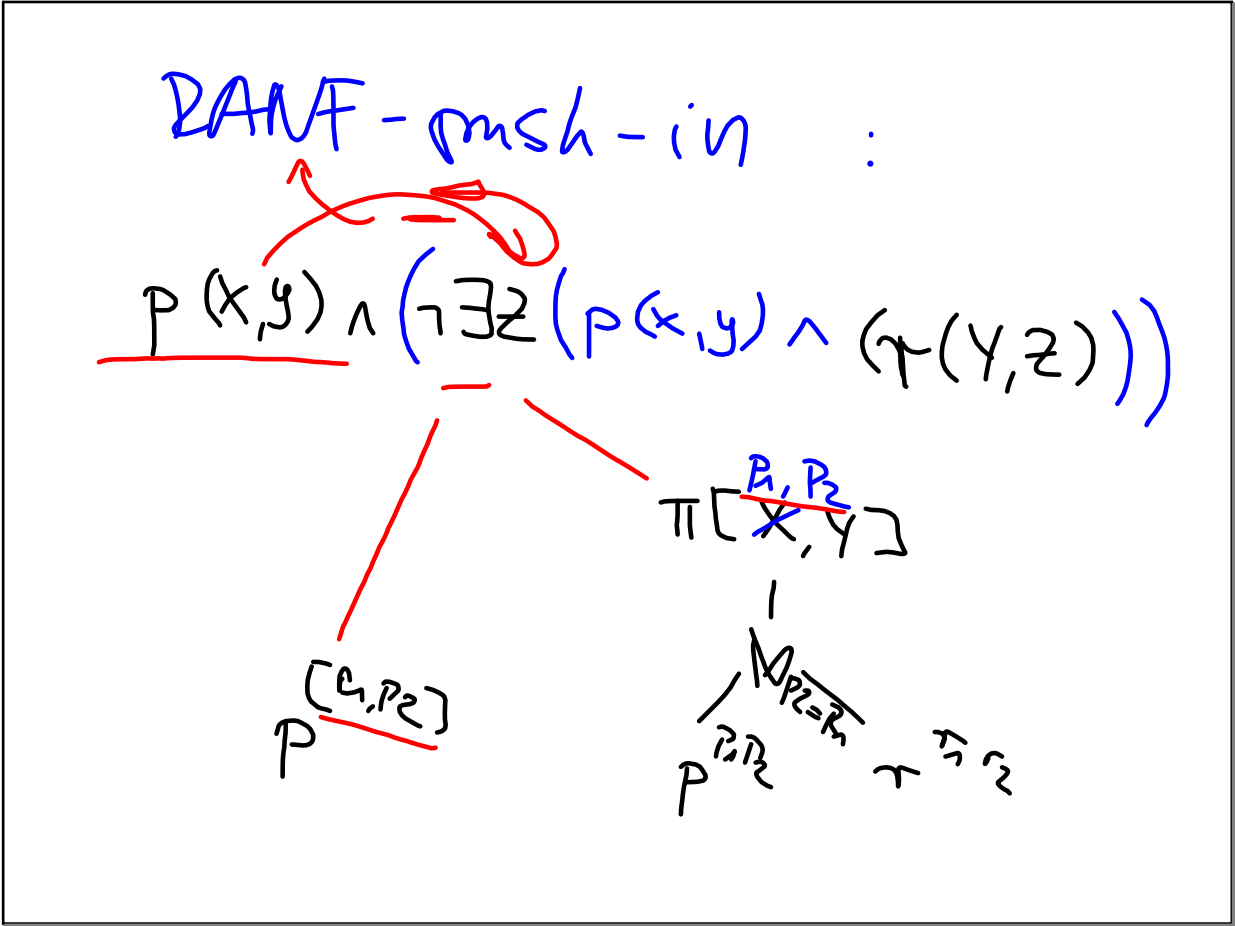
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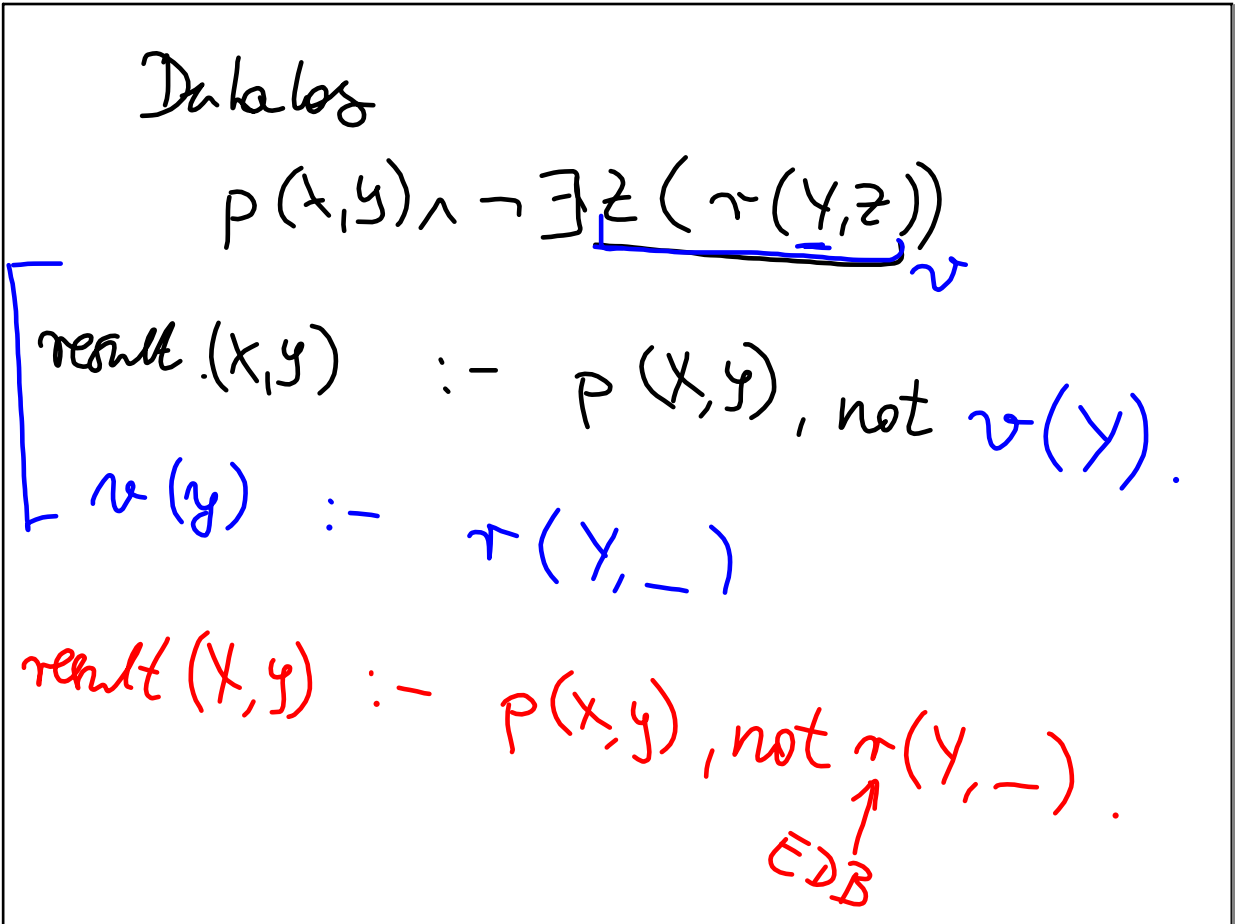
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