

The names of all countries that are members of the NATO which are not located in Europe

country (N, C, Cap, Gov, A, Pop)
 is member (C, O, T)
 encompasses (C, Cont, Perc)

$F(N) :- \exists C, Gp, Gov, A, Pop, T : \left(\begin{array}{l} \text{country}(N, C, Gp, Gov, A, Pop) \\ \wedge \text{is member}(C, 'NATO', T) \\ \wedge \neg \exists Perc : \text{encompasses}(C, 'Europe', Perc) \end{array} \right)$

$F(N) :- \exists X \left(F_1 \wedge F_2 \wedge \neg \exists Perc : F_3 \right)$

Free(F3) = {C, Perc} rr(F3) = {C, Perc}
 Free(F4) = {C} rr(F4) = {C}
 → Free(F5) = {C} rr(F5) = ∅
 Free(F6) = {C, Gp, Gov, A, Pop, T, N}
 rr(F6) = rr(E) ∪ rr(F2) ∪ rr(F5) = Free(F6)
 Perc(∅) = {N} rr(F) = {N} *F is scope number*

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$F(N) :- \exists C, Gp, Gov, A, Pop, T : \left(\begin{array}{l} \text{country}(N, C, Gp, Gov, A, Pop) \\ \wedge \text{is member}(C, 'NATO', T) \\ \wedge \neg \exists Perc : \text{encompasses}(C, 'Europe', Perc) \end{array} \right)$

consider bottom-up evaluation

... $\neg \exists Perc : Perc(C, 'Europe', Perc)$

$\overset{F5}{\text{read: free}(F5) = \{C\} \quad \text{not in RANF}}$
 $\text{rr}(F5) = \emptyset$

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$$F(N) = \exists \dots (F_1 \wedge F_2 \wedge \underbrace{\neg \dots}_{\text{not self-contrad}})$$

$$F(N) :- \exists C, Gp, Gp/Pop, A, Pop, T : \\ (\text{country}(N, C, Gp, Gp/Pop, A, Pop) \\ \wedge \text{isMember}(C, 'NATO', T) \\ \wedge \exists Perc : \text{encapsulates}(C, 'Europe', Perc))$$

$$F(N) :- \exists \dots \\ \text{country}(C, \dots) \\ \wedge \text{isMember}(C, \dots) \\ \wedge \exists Perc (\text{country}(C, \dots) \\ \wedge \text{enc}(C, \dots)) \\ \equiv \exists \dots (F_2 \wedge \exists Perc (F_1 \wedge F_3))$$

Algebra:

Country $\pi[c.code]$ \wedge isM

Country $\pi[c.code]$ \wedge $\sigma[Country='Europe']$ \wedge Perc

c.name
 c.name countries in Europe \Rightarrow NOT

$c.code = e.country$

$\sigma[Country='Europe']$

Perc

$N, C, Gp, Gp/Pop, A, Pop$
 $C, Gp/Pop, Perc = 'Europe'$

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$$\exists v (r(v, x) \wedge \neg s(x, y, v)) \\ \wedge \exists w (r(w, y) \wedge \neg s(y, x, w))$$

first step: push x, v and w, y into not

$$\exists v : \neg (r(v, x) \wedge s(x, y, v)) \\ \wedge \exists w : \neg (r(w, y) \wedge s(y, x, w)) \\ \wedge r(w, y) \wedge r(v, x) \quad \text{push into } \exists$$

$$\neg (r(w, y) \wedge r(v, x)) \wedge \exists v (r(v, x) \wedge r(w, y) \wedge s(x, y, v)) \\ \wedge \exists w (r(w, y) \wedge r(v, x) \wedge s(y, x, w))$$

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$$F(\mathbb{X}) :- \forall y. (\underline{\text{contlet}(y)} \rightarrow \text{enc}(x, y))$$

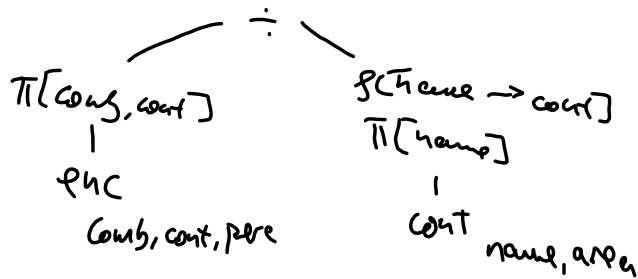
$$\forall y (\neg \text{cont}(y) \vee \text{enc}(x, y))$$

$$F(\mathbb{C}) :- \text{cont}(\mathbb{X}) \wedge \forall y (\neg \text{cont}(y) \vee \text{enc}(x, y))$$

$$\text{cont}(\mathbb{X}) \wedge \neg \exists y (\text{cont}(y) \wedge \neg \text{enc}(x, y))$$

≈

$\text{enc} \dot{\div} \text{cont}$



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