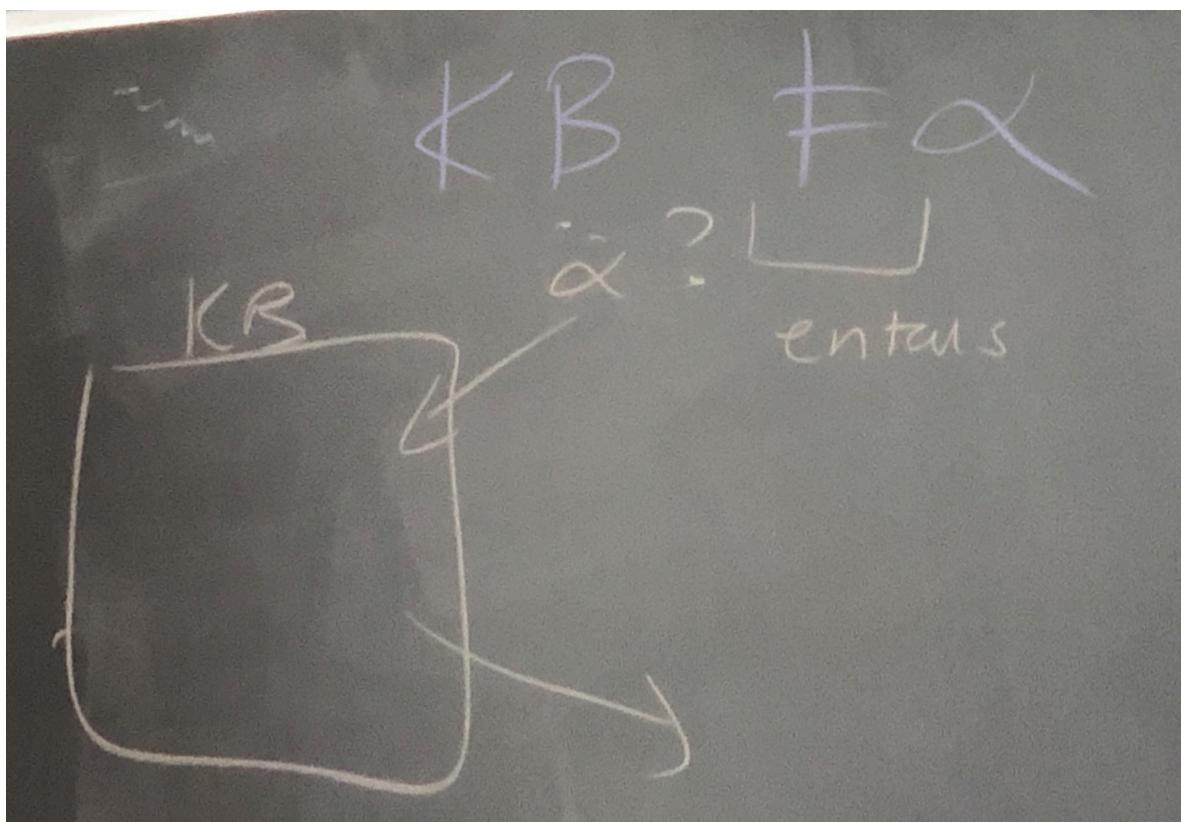


L3 Reasoning techniques

Terms:

Knowledge Base (KB) -



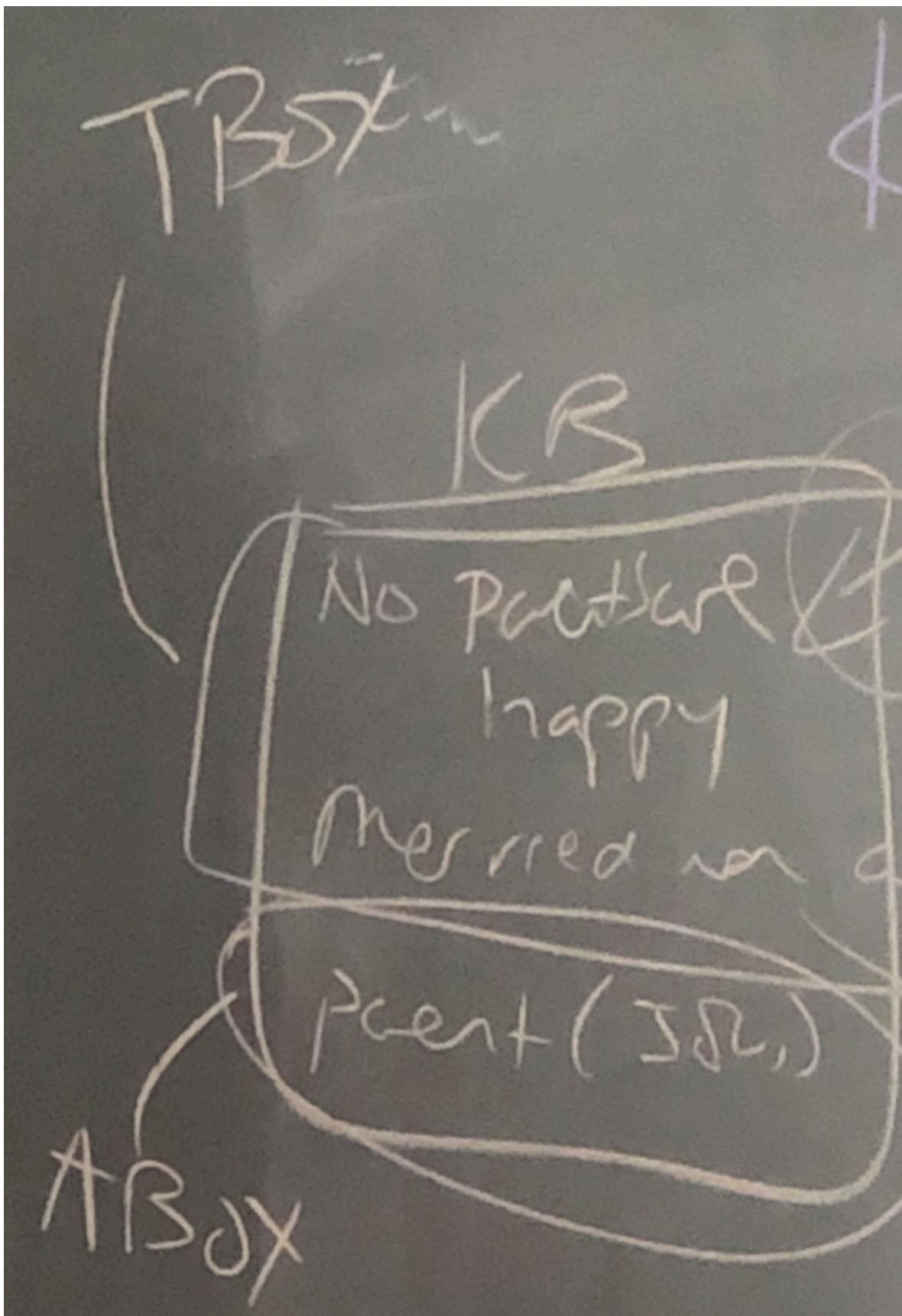
Procedure/algorithm -

The diagram shows a vertical line with a horizontal bar extending from it, followed by the text "procedure to find" and "if α follows from KB ".

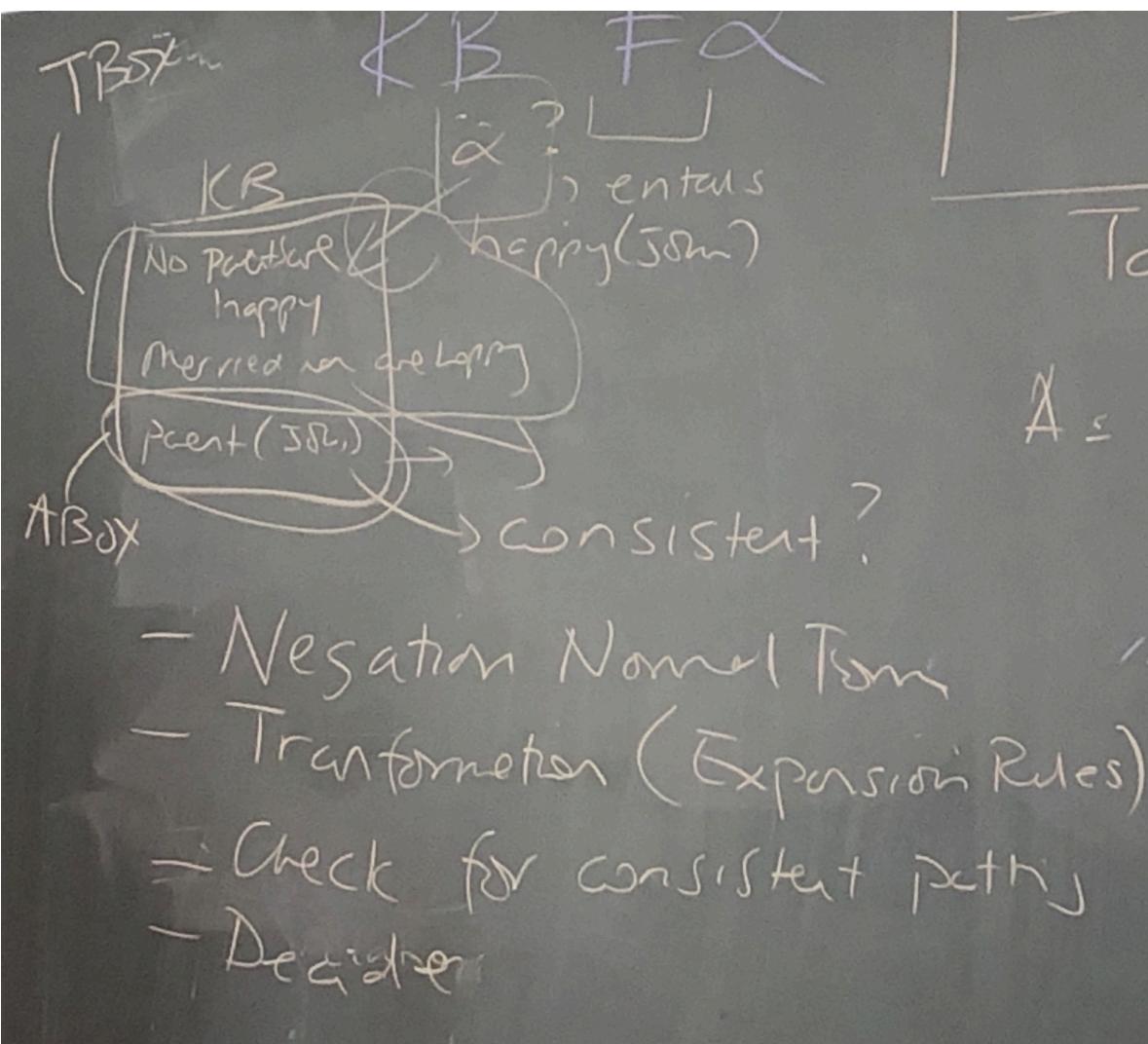
Is it a sound procedure?

Sound : if it produces an answer
It is ~~exact~~
Complete. if it produces all the
terminations; if it always stops
Correct answers

TBox / ABox:



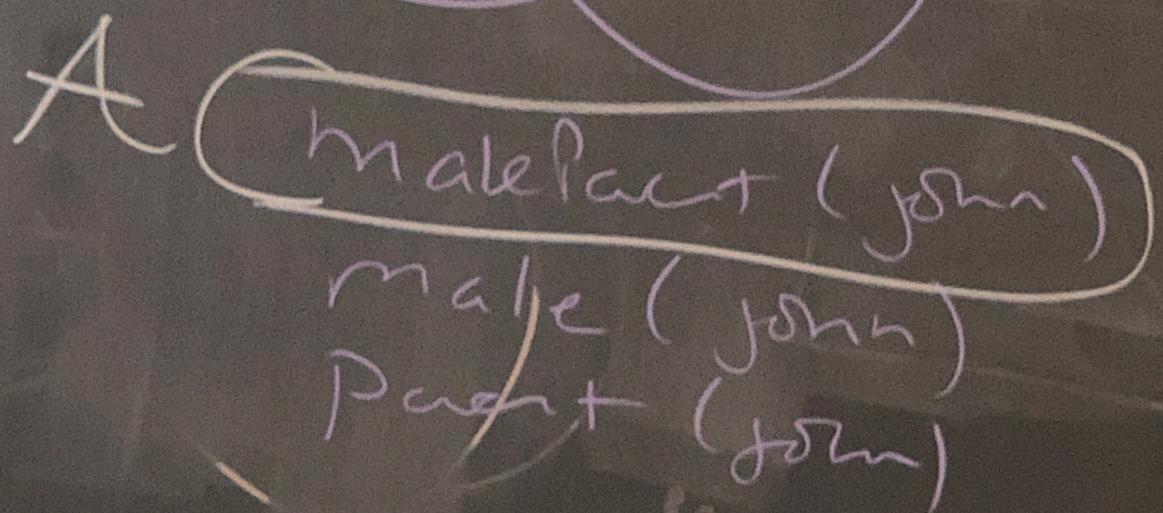
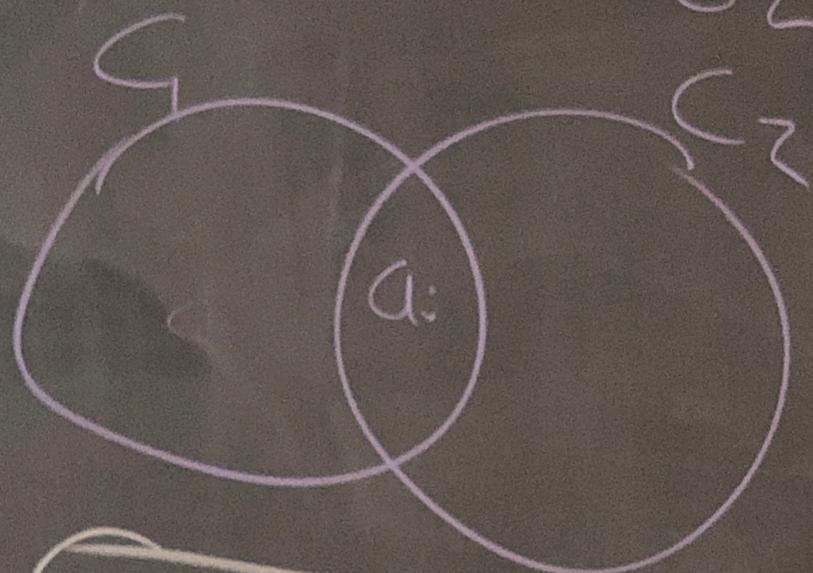
How to make sure your "model" is consistent:



Negation Normal Form (NNF)

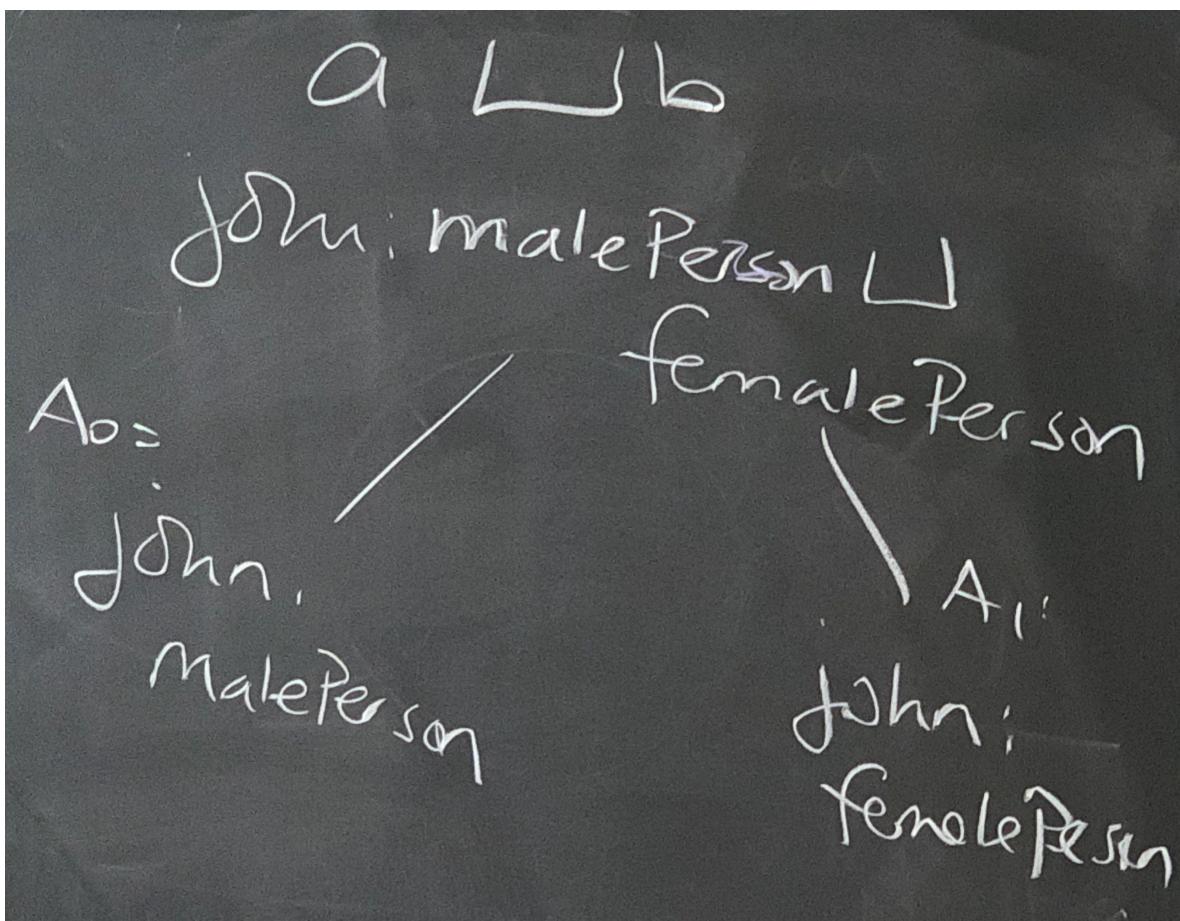
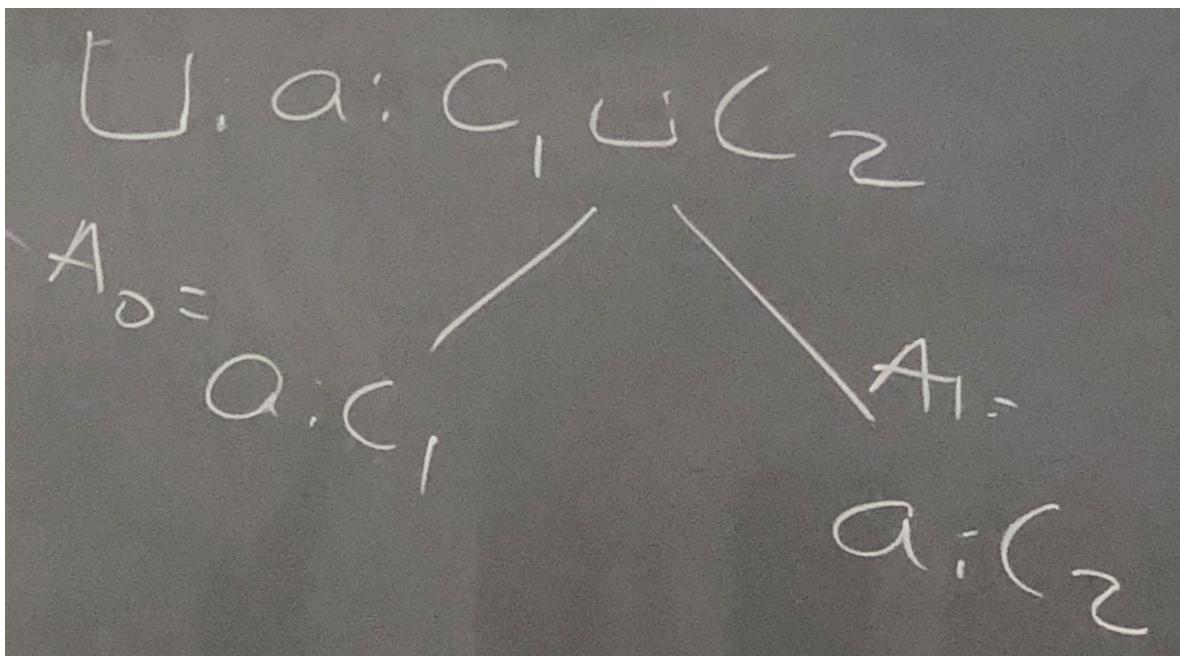
□ rule (with ABox maleParent(John))

$$A = a_1 : C_1$$
$$a : C_2$$



□ rule

(branching out; one consistent branch is enough to make the conclusion)



\exists rule

(has at least one..., ie. child)

a. $\exists s. C \subseteq A$

$\exists \text{hasCh. Id. Person}$
d

John: $\exists \text{hasCh. Id. Person}$
 $\text{hasChild}(\text{john}, d)$

v rule
(forAll relation)

$\forall s. C, (a, b). s \subseteq A$

John: $\forall \text{hasChild. MalePerson}; \text{hasChild}(\text{john}, \text{matt})$
math: malePerson

John: $\exists \text{hasCh. Id. Person}$
 $\text{hasChild}(\text{john}, d)$

Consistency Example
(which is not consistent as we found a clash)

$T = \forall \text{hasChild. MalePerson} \sqcap (\exists \text{hasChild. } \neg \text{MalePerson})$
 A: John, \nearrow only sons \sqcap at least one non-male children
 $\neg \text{hasChild. MalePerson}$, John: $\exists \text{hasChild. } \neg \text{MalePerson}$
 $b: \text{malePerson} \leftarrow \text{hasChild}(John, b)$
 $= \text{clash!} \rightarrow b: \neg \text{malePerson}$

Query example (1)

(we use introduced negation to confirm a clash which confirms Mary is a doctor)

$T = \text{Doctor} \sqsubseteq \text{Person}, \text{Parent} \sqsupseteq \text{Person} \sqcap \exists \text{hasChild. Person}$
 $\text{HappyParent} \sqsubseteq \text{Parent} \sqcap \forall \text{hasChild. Doctor}; \text{many. } \neg \text{doctor}$
 A: $\{ \text{John. HappyParent, hasChild(John, Mary)} \}$
 $\text{John: Parent, } \text{John: } \forall \text{hasChild. Doctor}$
 $\text{John: Person, John: } \exists \text{hasChild. Person}$
 $\text{Mary: doctor} \leftarrow$

Query example (2)

(no clash so I can't say Mary is a doctor)

$T = \text{Doctor} \sqsubseteq \text{Person}, \text{Parent} \sqsupseteq \text{Person} \sqcap \exists \text{hasChild. Person}$
 $\text{HappyParent} \sqsubseteq \text{Parent} \sqcap \forall \text{hasChild. Doctor} \sqcup \exists \text{hasChild. Doctor}$
 A: $\{ \text{John. HappyParent, hasChild(John, Mary)} \}$
 $\text{John: Parent, John: } \forall \text{hasChild. Doctor} \sqcup \exists \text{hasChild. Doctor}$
 $\text{Mary: } \neg \text{doctor, John: Person, John: } \exists \text{hasChild. Doctor}$
 $\times \{ \text{Mary: Doctor} \} \rightarrow \text{Mary: Doctor} \sqcup \exists \text{hasChild. Doctor}$
 $\text{Mary: Doctor} \sqcup \exists \text{hasChild. Doctor}$
 $\text{Mary: Doctor} \leftarrow \text{Mary: } \exists \text{hasChild. Doctor}$
 hasChild(Mary, b)
 $b: \text{doctor} \quad b: \text{person}$

I can't say
Mary is a doctor

Query example (3)

(clash! as we have derived nothing)

$T = \text{Doctor} \subseteq \text{Person}, \quad \text{Parent} \subseteq \text{Person} \quad \exists \text{hasChild} \cdot \text{Person}$
 $\text{HappyParent} \equiv \text{Parent} \sqcap \forall \text{hasChild} \cdot (\text{Doctor} \sqcup \exists \text{hasChild} \cdot \text{Doctor})$
 $A: \{ \{ \text{John}, \text{HappyParent}, \text{hasChild}(\text{John}, \text{Mary}), \text{Mary}, \text{hasChild}, \perp \}$
 $\quad \{ \{ \text{John}, \text{Parent}, (\text{John} \wedge \text{hasChild})(\text{Doctor} \sqcup \exists \text{hasChild} \cdot \text{Doctor}) \}$
 $\quad \{ \{ \text{Mary}, \text{Doctor}, \text{John} \cdot \text{Person}, \text{John}, \exists \text{hasChild} \cdot \text{Person} \}$
 $\quad \{ \{ \text{Mary}, \text{Doctor} \sqcup \exists \text{hasChild} \cdot \text{Doctor} \}$
 $\quad \{ \{ \text{Mary}, \text{hasChild}, \text{Doctor} \}$
 $\quad \{ \{ \text{Mary}, \text{hasChild}(\text{Mary}, b) \}$
 $\quad \{ \{ b = \perp \}$
Mary is a doctor