

Reasoning With Bounded Self-Reference Using Logical Interpreters

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$ALCQme_2 \approx ALCHI Q + \exists R.Self + \text{safe Boolean role combinations (in particular role conjunctions)}$
Expressive ✓ Low complexity ✓ **Can be handled by off-the-self reasoners**

New machinery needed: Logical Interpreters

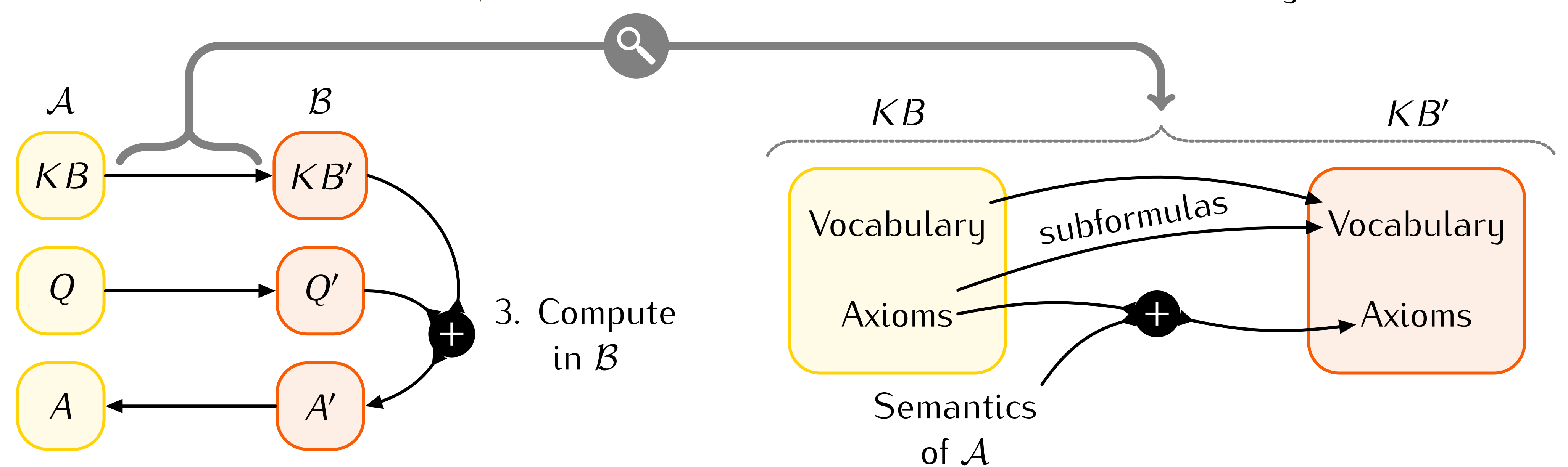
Say you want to implement a novel DL, then...

- writing a reasoner from scratch is expensive
- extending reasoners is difficult for multiple reasons
 - ⚡ feature conflicts
 - ⚡ software engineering issues

Logical Interpretation of DL \mathcal{A} in DL \mathcal{B} :

- Translate \mathcal{A} -KB into \mathcal{B} -KB
- Reduce \mathcal{B} -Models to \mathcal{A} -Models
- Invariance of satisfaction \rightarrow Borrowing

1. Translate the KB
2. Translate the query
3. Compute in \mathcal{B}
4. Reduce the answer



$ALCQme_2 - ALCQ$ with 2-bounded self-reference

Extends $ALCQ$ by:

- the operator I : remembers current point of evaluation
- the concept me : only holds at remembered point

At most 2 quantifiers in between (allowing 3 would lead to undecidability)

Example: Narcissist

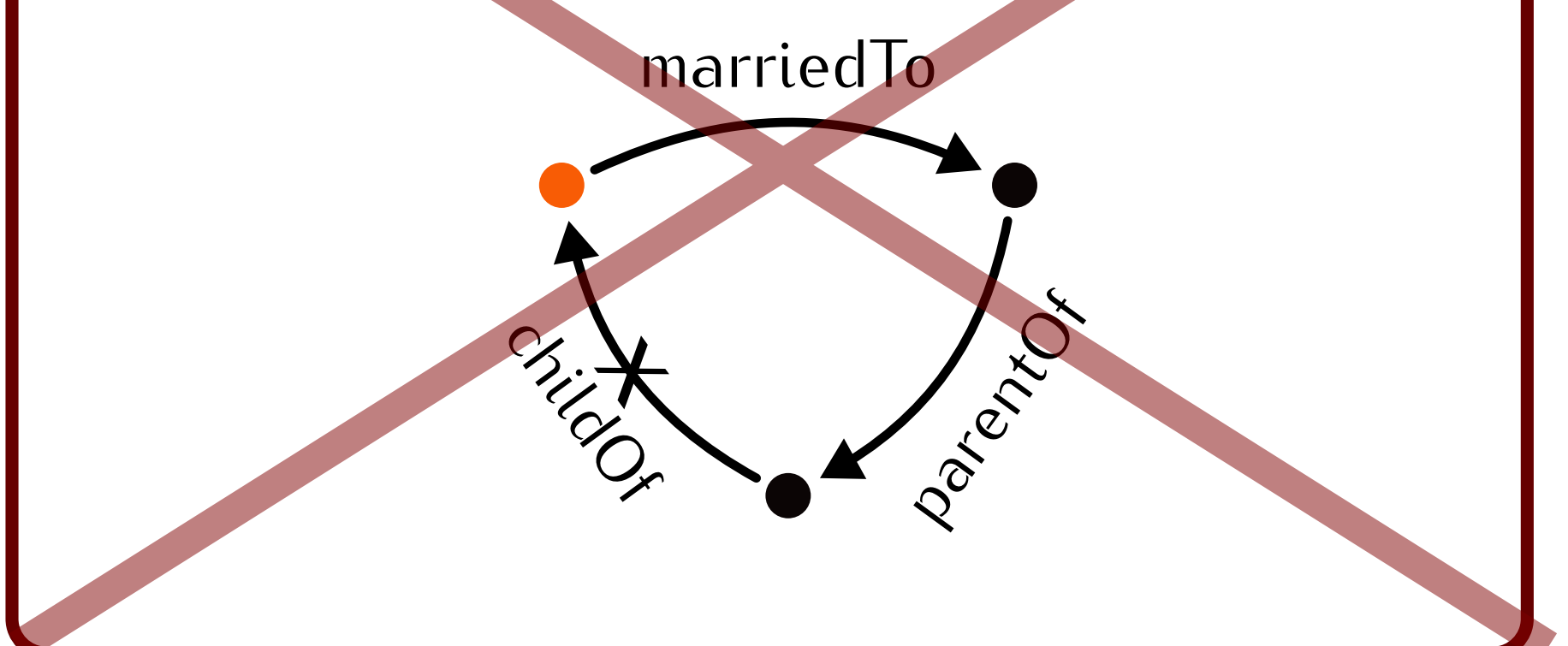
$I.\exists \text{ loves. me}$

Example: Celebrity

$I.\forall \text{ meets. } \exists \text{ knows. me}$

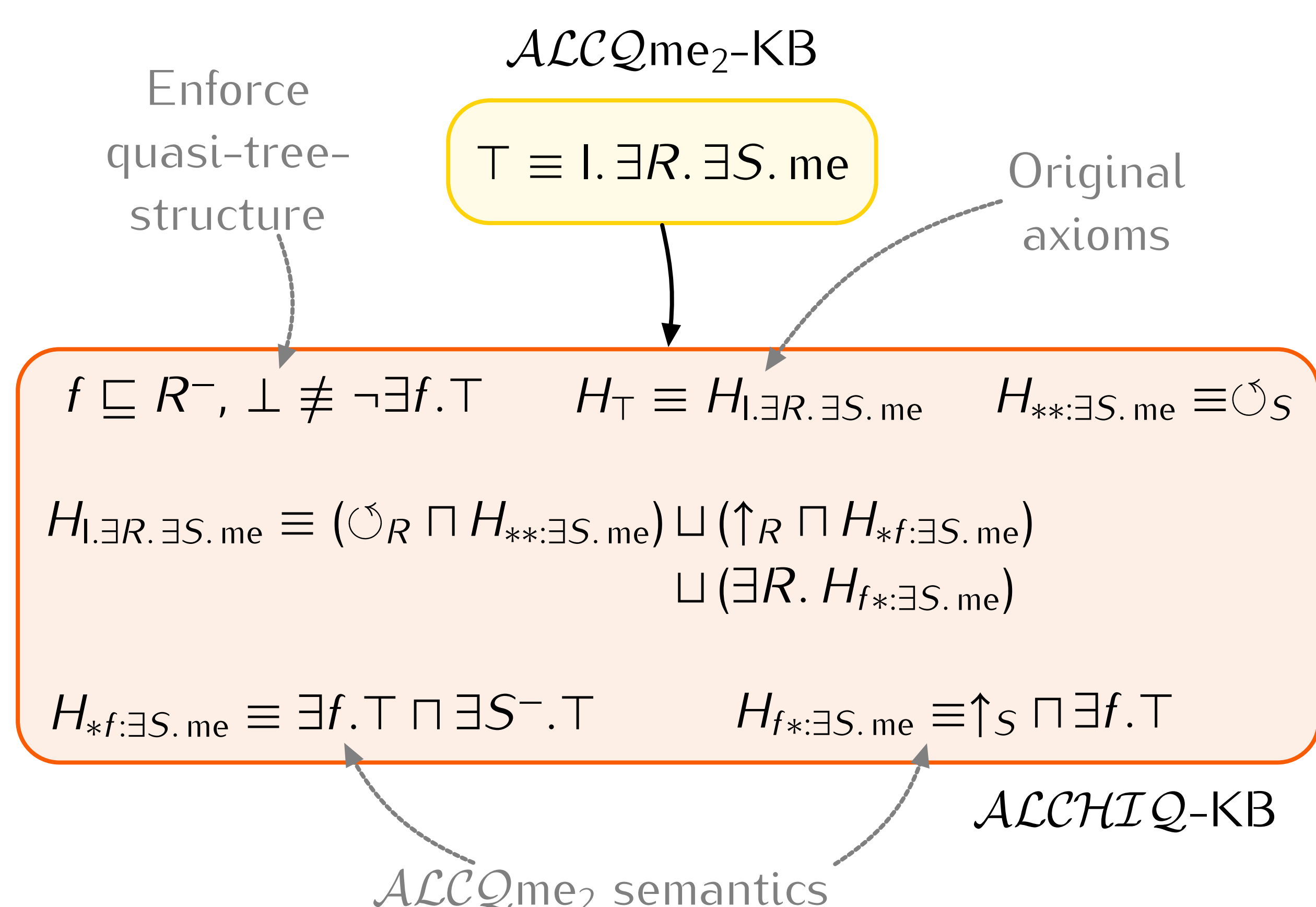
Non-Example: Step-parent

$I.\exists \text{ marriedTo. } \exists \text{ parentOf. } \neg \exists \text{ childOf. me}$



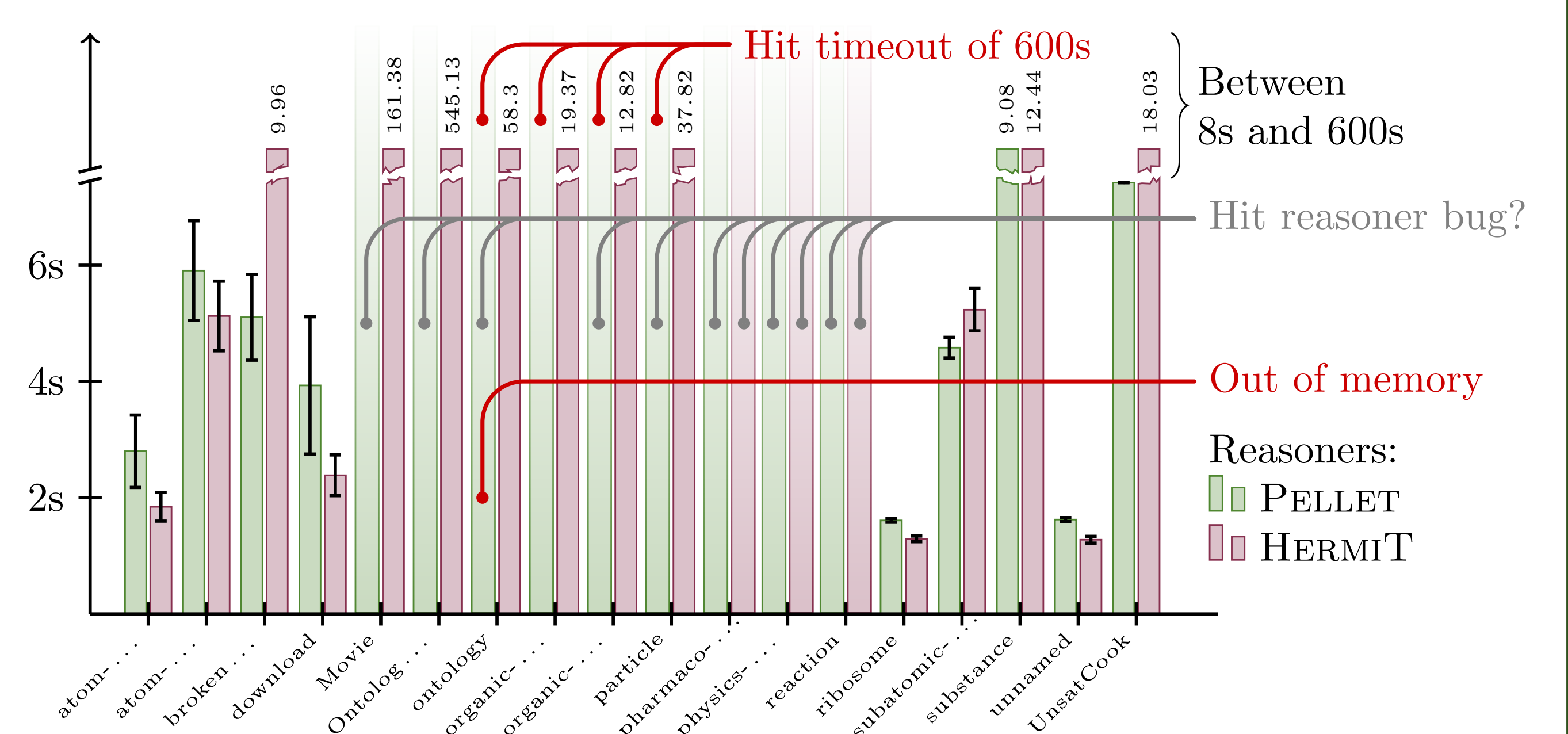
Interpreting $ALCQme_2$ in $ALCHI Q$ in theory...

- Exploit quasi-tree model property of $ALCQme_2$
- Introduce a functional role f for the father-of relation
- Encode remembered point relatively in the concept names



...and in practice

- Take KBs from Tones, extend them randomly with I and me
- Is the consistency checking time still reasonable?



Most instances could be solved within reasonable time limits!

$\Rightarrow ALCQme_2$ can be handled by reasoners ✓