Computing Stable Models for Nonmonotonic Existential Rules
Despoina Magka, Markus Krötzsch, Ian Horrocks

What is this poster about?
✓ Ontology languages, i.e. formalisms that try to establish a common language between humans and machines
✓ Design of a new ontology language for structured entities
✓ Complexity study of its properties/experiments over a biochemical ontology

Limitations of OWL
✓ OWL family consists of powerful ontology languages, widely adopted for building biomedical ontologies
✓ But OWL cannot faithfully represent cyclic structures, which abound in life sciences (and other) domains

Need for more expressivity
✓ ChEBI ontology
✓ Reference terminology adopted for chemical annotation by bio-ontologies
✓ Applications: drug discovery, study of metabolic pathways, ...
✓ ChEBI taxonomy is manually curated
✓ Automation of classification is hindered by the cyclic shape of many ChEBI objects

A new approach
The language
✓ Nonmonotonic existential rules, i.e. rules with nonmonotonic negation in the body and existentials in the head
✓ Interpreted under stable model semantics
✓ New conditions based on analysis of interactions between rules
✓ R-acyclicity (coNP-complete to check)
✓ Ensures finiteness of the stable model
✓ R-stratification (coNP-complete to check)
✓ Ensures uniqueness of the stable model
✓ Strictly extends classical stratification
✓ Allows to captures both conditional and definitional aspects of structured objects

The complexity
coN2EXPTIME-complete
2EXPTIME-complete complexity
R-acyclic
R-acyclic+
R-stratified
coNP-complete
PTIME-complete complexity
R-acyclic
R-acyclic+
R-stratified

The evaluation
✓ Case study over ChEBI using DLV
✓ Constructed knowledge base of 78,957 rules
✓ Derived 8,639 subclass relations in 13.5 secs
✓ R-stratification enabled DLV to scale
✓ Exposed missing subsumptions for manually curated ChEBI ontology