Computing Stable Models for Nonmonotonic Existential Rules

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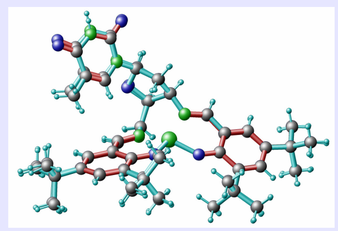
IJCAI-13

What is this poster about?

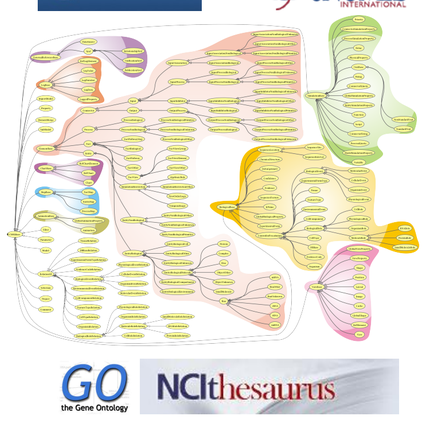


- ✔ Ontology languages, i.e. formalisms that try to establish a common language between humans and machines
- ✔ Design of a new ontology language for structured entities
- ✔ Complexity study of its properties/experiments over a biochemical ontology

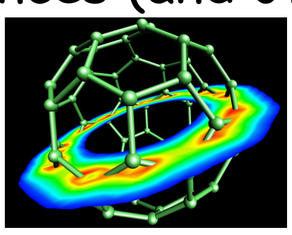
Limitations of OWL

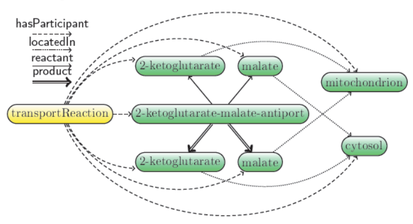
- ✔ OWL family consists of powerful ontology languages, widely adopted for building biomedical ontologies

BioPortal SNOMED INTERNATIONAL



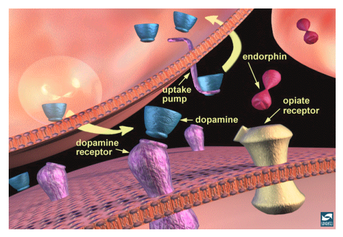
- ✔ But OWL cannot faithfully represent cyclic structures, which abound in life sciences (and other) domains





Need for more Expressivity

- ✔ ChEBI ontology EMBL-EBI
- ✔ 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

- ✔ Nonnmonotonic 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 inter-actions 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	Program complexity	R-acyclic
2EXPTIME-complete		R-acyclic+ R-stratified
coNP-complete	Data complexity	R-acyclic
PTIME-complete		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