Computing Inferences for Credal $\mathcal{ALC}$ Terminologies

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Quick overview

- Goal: to build a package that performs inferences in terminologies that combine probabilities with $\mathcal{ALC}$-style constructs.
- Language is called Credal $\mathcal{ALC}$ (Cr$\mathcal{ALC}$).
- Short paper reports on initial development (mostly by first author).
- Current effort: to implement lifted inference algorithms (mostly by third author).

Cr$\mathcal{ALC}$ - Example

- Individuals, concepts, roles.
- *Extends* $\mathcal{ALC}$ constructors with ***probabilistic inclusions***
  - *P(C|D)=*α, interpreted as: for every element x of domain, *P(C(x)|D(x))=* α.
  - *P(r)=*β, interpreted as: for every pair (x,y) of elements of the domain, *P(r(x,y))=* β.
- Acyclic terminology

$B \sqsubseteq A$

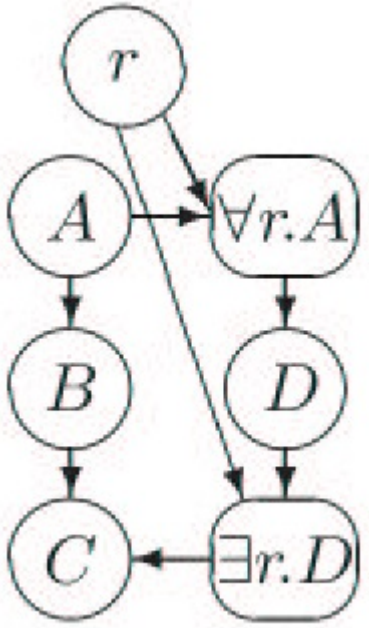
$C \sqsubseteq B \sqcup \exists r.D$

P(A)=0.9,

P(B|A)=0.4

P(C | B $\sqcup$ *∃r.D)=0.6*

P(D|∀r.A)=0.3

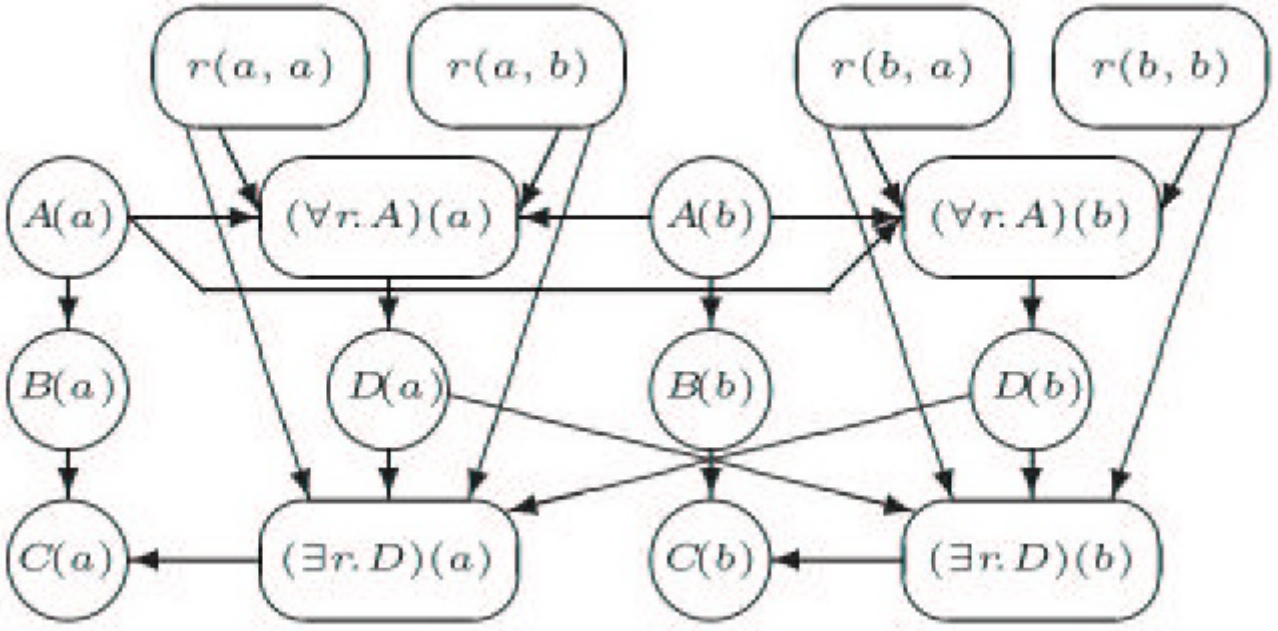


CrALC - Inference

- The challenge is to compute the probability of an assertion, conditional on other assertions.
  - *P(D(a)|B(b))* = ?
    - One solution: generate propositional Bayesian network, solve it.

Inference in Cr$\mathcal{ALC}$ - Example

- *Domain*={a,b}



- Markov condition guarantees interpretation as relational Bayesian network.
- *P(D(a)|B(b))* = 0.232

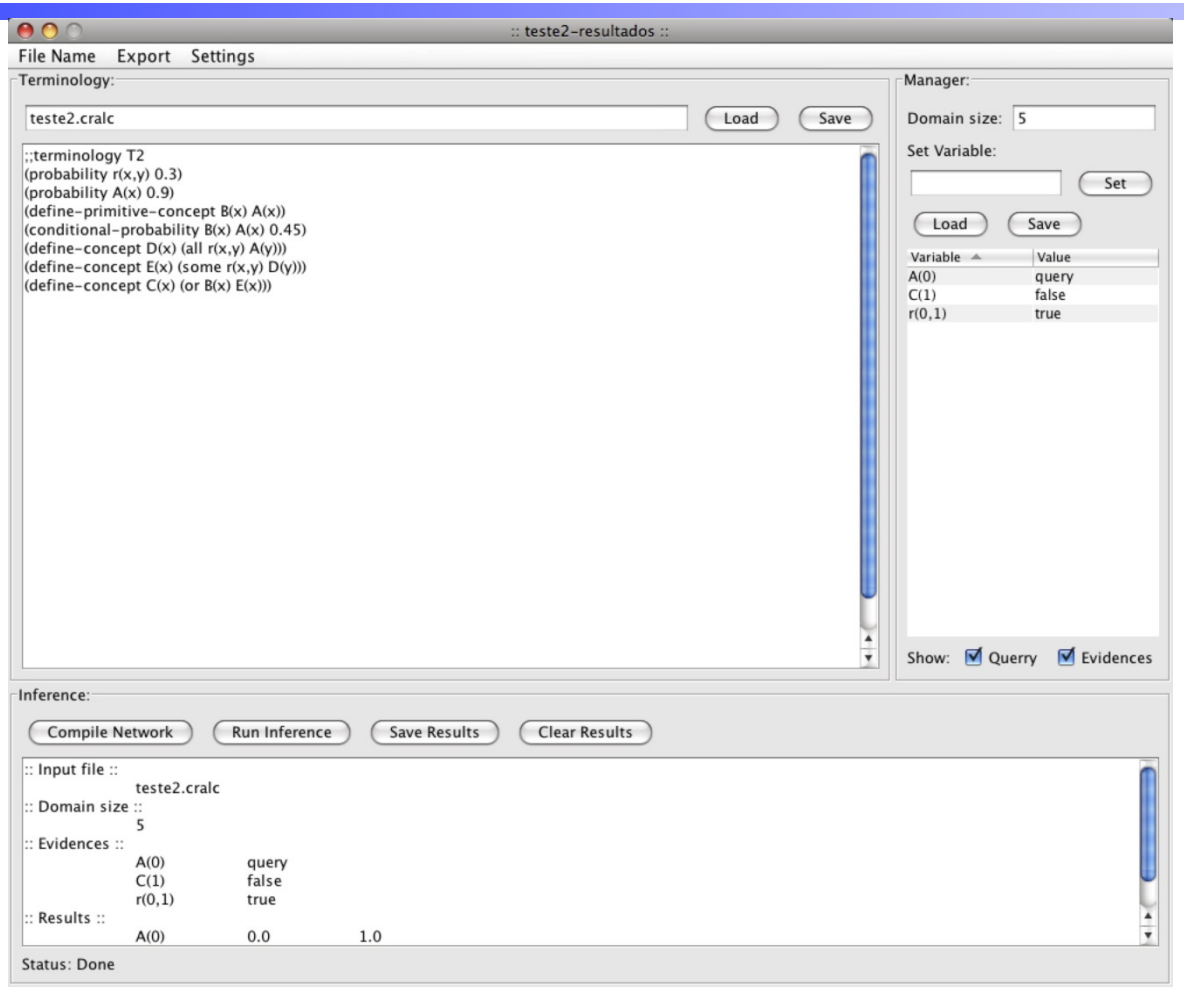
CrALC - Inference

- The challenge is to compute the probability of an assertion, conditional on other assertions.
  - *P(D(a)|B(b))* = ?
    - One solution: generate propositional Bayesian network, solve it.
      - too hard…
    - Another solution: variational approximation method by Polastro.
      - approximate, and still not very easy….
    - Yet another solution: lifted inference (under implementation…).

- But the problem is that there is no available package to easily run these algorithms.

A Package

- Adopts specification by enhanced KRSS (Knowledge Representation System Specification).
- Preliminary (free) implementation with variational inference.
- Lifted inference is next step.



http://sites.poli.usp.br/pmr/ltd/Software/CRALC/index.html

Questions?