Projectivity and Probabilistic Logic Programming

Felix Weitkämper
LMU München

Projective families of distributions have been isolated as those families with the strongest scaling properties:

They allow for inference in constant time with respect to domain size and support statistically consistent parameter estimation from randomly sampled subsets of a training domain.

Projective families without the (conditional) independence property

- The unlabelled equal distribution of isomorphism types of structures
- The distributions of Carnap's continuum of inductive methods
- Projective families whose De Finetti representations have infinite support

Determinate PLPs

```
R(x,y) :- B(x), B(y).
0.1::R(x,y) :- R(y,x), B(x).
0.3::B(x) :- P.
```

These are the "essentially propositional" PLPs that can be expressed using quantifier-free definitions over probabilistic facts.

Indeterminate PLPs

```
0.5::C(x) :- R(x,y), B(y).
0.2::R(x,z) :- R(x,y), R(y,z).
```

Those PLPs that have variables in the body which do not occur in the head of the same clause.

They are precisely those PLPs which (implicitly) invoke existential quantification.

Probabilistic Logic Programs under the distribution semantics (PLPs) are widely used representations in statistical relational AI.

They support cyclical dependencies and subsume ground Bayesian networks in expressivity.

This makes PLPs promising for studying the expressive power of statistical relational frameworks.

Weitkämper, Felix: An Asymptotic Analysis of Probabilistic Logic Programming, with Implications for expressing Projective Families of Distributions. To appear in: Theory and Practice of Logic Programming.