

Using Probabilistic Logic Programming to Find Patterns

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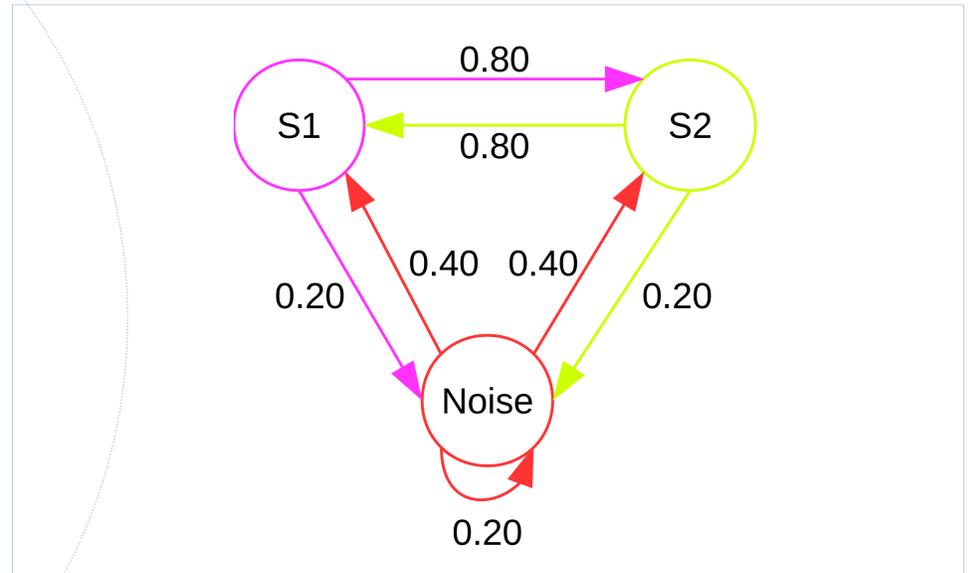
ProbLog Semantics

Probabilistic Logic Programming Language
 Distribution Semantics (T. Sato, ICLP 1995)

MetaProbLog

- Full Negation
- Flexible(intensional) Probabilistic Facts
- Annotated Disjunctions
- Meta calls (High order calls)
- Efficient Inference
 - Exact (Marginals and Conditional)
 - Program Sampling (Marginals and Conditional)
 - Most Probable Explanation (MPE)

www.dcc.fc.up.pt/metaproblog



```
0.80::trans(s1,s2,T1,T2);
0.20::trans(s1,noise,T1,T2) <- next(T1, T2).

0.80::trans(s2,s1,T1,T2);
0.20::trans(s2,noise,T1,T2) <- next(T1, T2).

0.40::trans(noise,s1,T1,T2);
0.40::trans(noise,s2,T1,T2);
0.20::trans(noise,noise,T1,T2) <- next(T1, T2).

0.20::start(noise,0);
0.40::start(s1,0);
0.40::start(s2,0) <- true.

signal(State, 0) :- start(State, 0).
signal(State2, T2) :-
    trans(State1,State2,T1,T2),
    signal(State1, T1).

next(T1, T2) :- integer(T1), !, T2 is T1 + 1.
next(T1, T2) :- integer(T2), T1 is T2 - 1.
```

ProbLog Models

- Graphical Models
- Bayesian Networks
- Hidden Markov Models
- Probabilistic Graphs
- Any Logic Program (Relational Databases)

ProbLog Applications

- Link Discovery in Biomine Alzheimer database.
- WebKB: discovering the relation among two webpages.
- Probabilistic Dictionary: discover the probability that two words are synonyms.
- Model Mobile Ad hoc Networks and analyses of Fadip.
- Robotic affordance model learning.

Classification of phonocardiogram (PCG) signals

Model PCG signals as HMMs
 Use Gaussian distributions for signal features to probabilities
 Use counting for calculating the HMM parameters
 Future work: learn the HMM parameters

```
% Query 1: Probability of a state
?- problog_exact(signal(s1,5),P).
P = [0.4]

% Query 2: Conditional probability of a state
% with prior knowledge
?- problog_exact(signal(s1,5)/start(s1,0),P).
P = [0.23616]

% Query 3: Most probable explanation of a query
?- problog_mpe(signal(s1,5),Res).
Res = [0.131072/[start(s2,0)->true,
    trans(s2,s1,0,1)->true,
    trans(s1,s2,1,2)->true,
    trans(s2,s1,2,3)->true,
    trans(s2,s1,4,5)->true,
    trans(s1,s2,3,4)->true]]
```

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