Probabilistic answer set programming for argumentation mining

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Contents

Probabilistic Logic Programming

```
0.3::stress(X) :- person(X).
0.2::influences(X,Y) :- person(X), person(Y).

smokes(X) :- stress(X).
smokes(X) :- friend(X,Y), influences(Y,X), smokes(Y).

0.4::asthma(X) :- smokes(X).

person(angelika).
person(joris).
person(jonas).
person(dimitar).

friend(joris,jonas).
friend(joris,angelika).
friend(joris,dimitar).
friend(angelika,jonas).
```

Figure: Example of a ProbLog program, from Fierent et al. (2015).

Probability of a total choice

A **total choice** Θ selects a subset of probabilistic facts.

$$P(\Theta) = \prod_{f \in \Theta} p_f \prod_{f \notin \Theta} (1 - p_f)$$

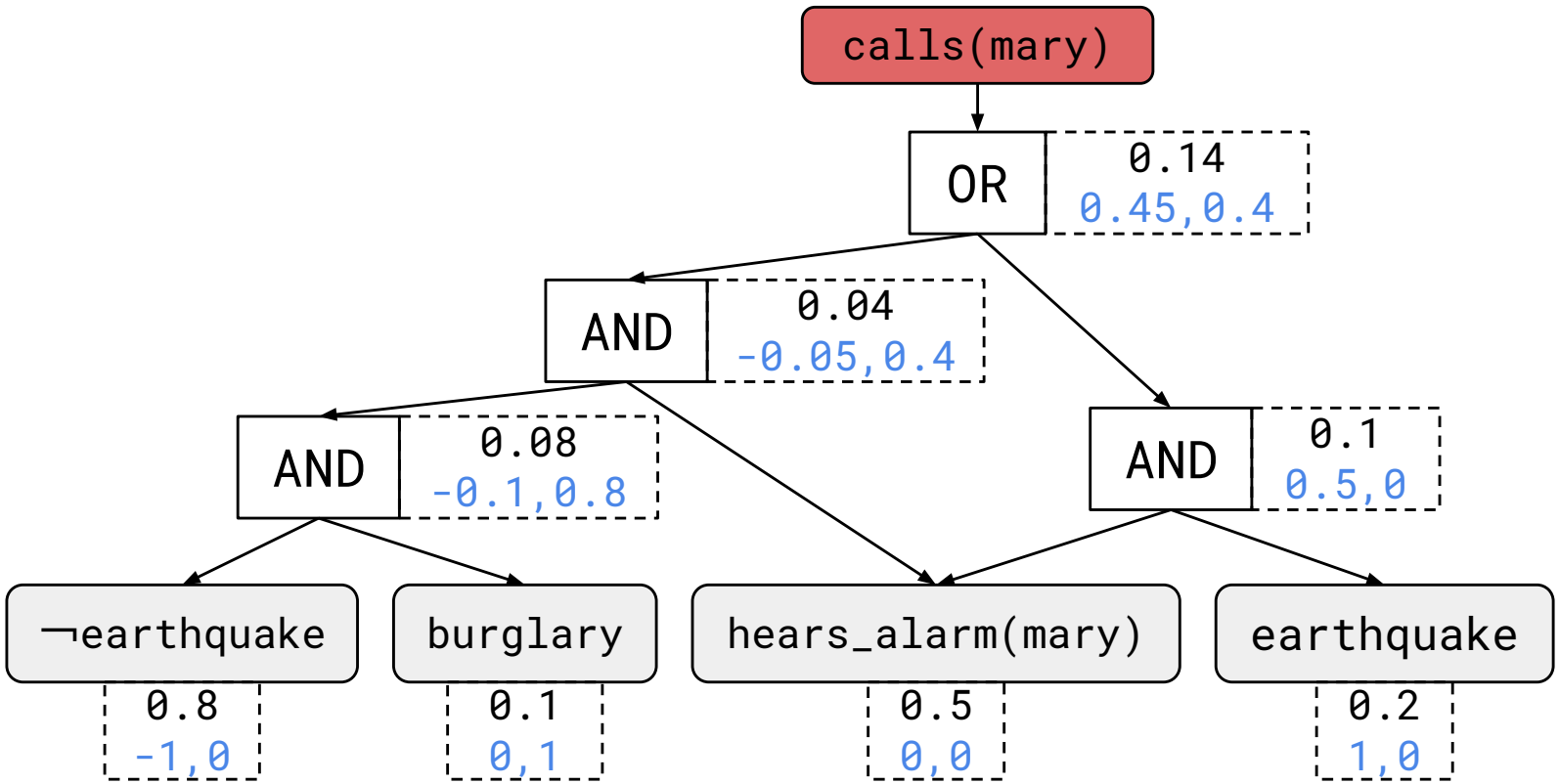
Probability of a query

$$P(Q) = \sum_{\Theta : M_\Theta \models Q} P(\Theta)$$

Sum of all choices whose model makes Q true.

Knowledge Compilation

```
0.2::earthquake. 0.1::burglary. 0.5::hears(mary).
alarm :- earthquake. alarm :- burglary.
calls(mary) :- alarm, hears(mary).
```



Probabilistic Answer Set Programming (PASP)

```
0.5::b(1).
0.5::a(1).
x(1) :- a(1).
y(1,0); y(1,1) :- x(1).
y(1,0) :- b(1), not x(1).
y(1,1) :- not b(1), not x(1).
```

Non-stratified PASP program, representing an Imprecise Hidden Markov Model.

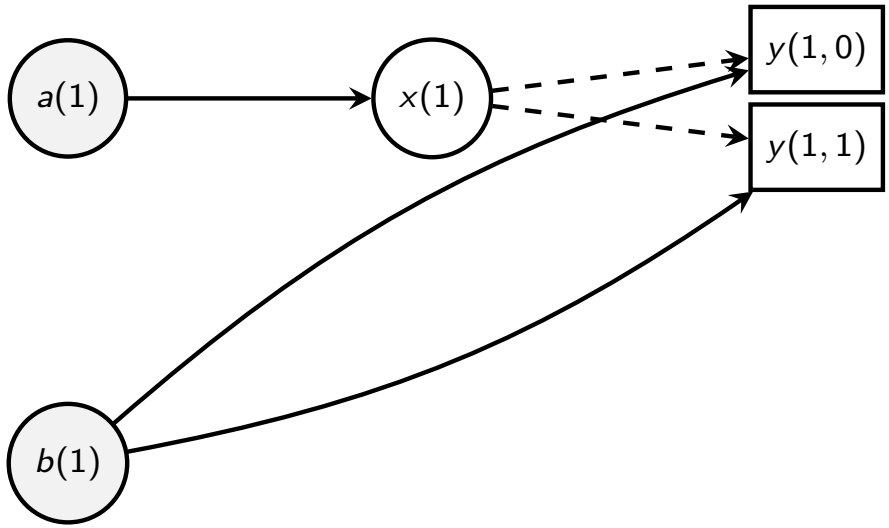


Figure: Graphical representation of the PASP Imprecise HMM program in Listing 1.

Negation Normal Form (NNF)

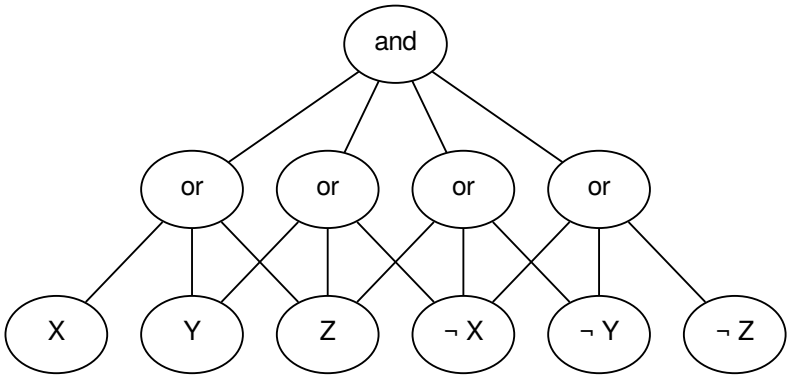


Figure: Example of a CNF formula in the NNF language.

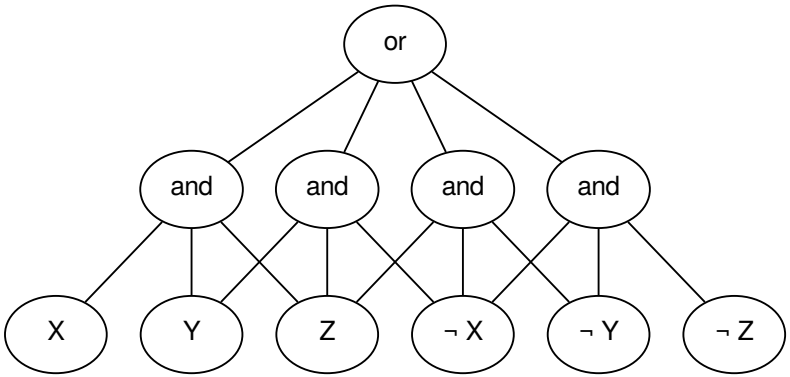
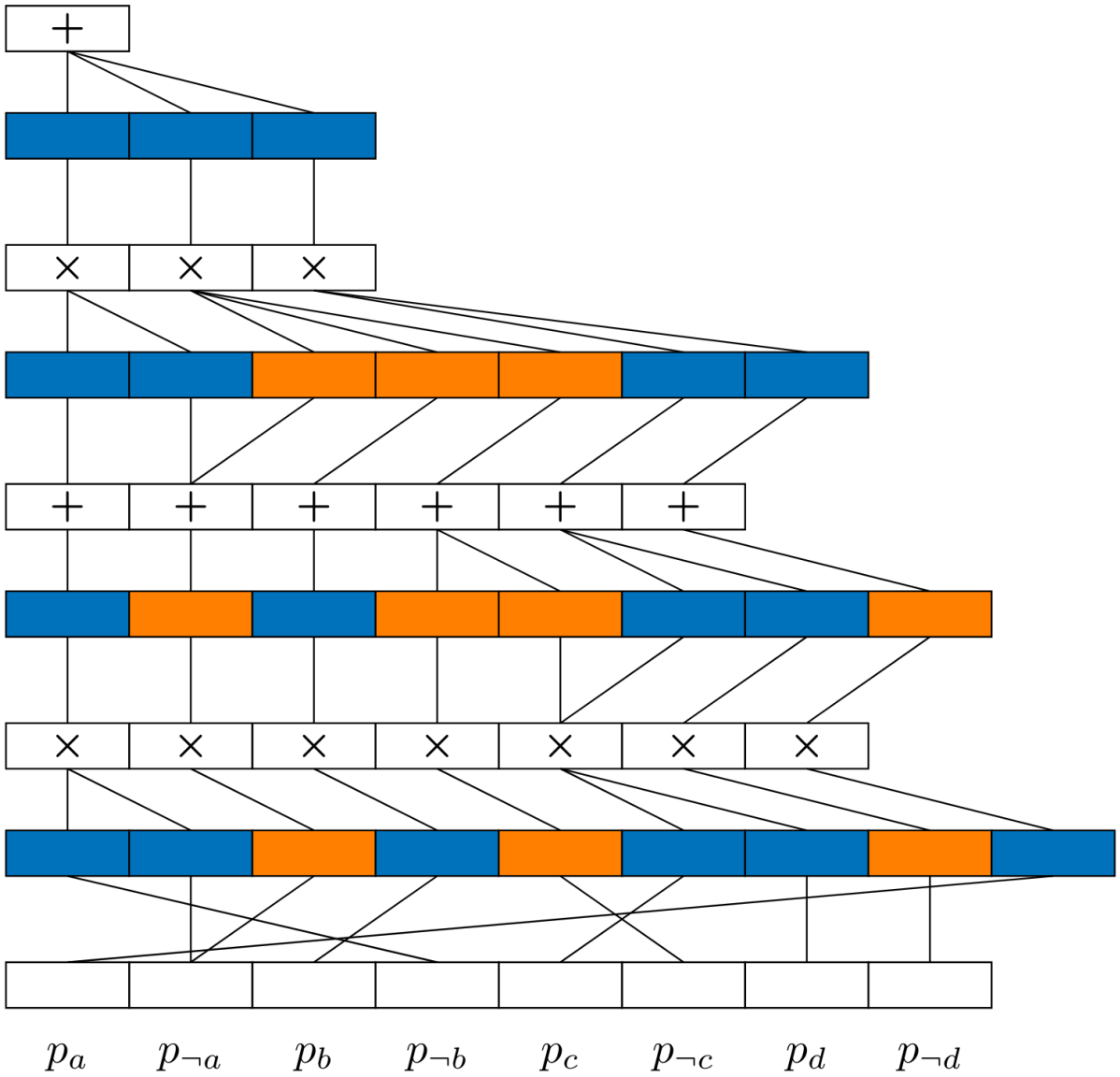
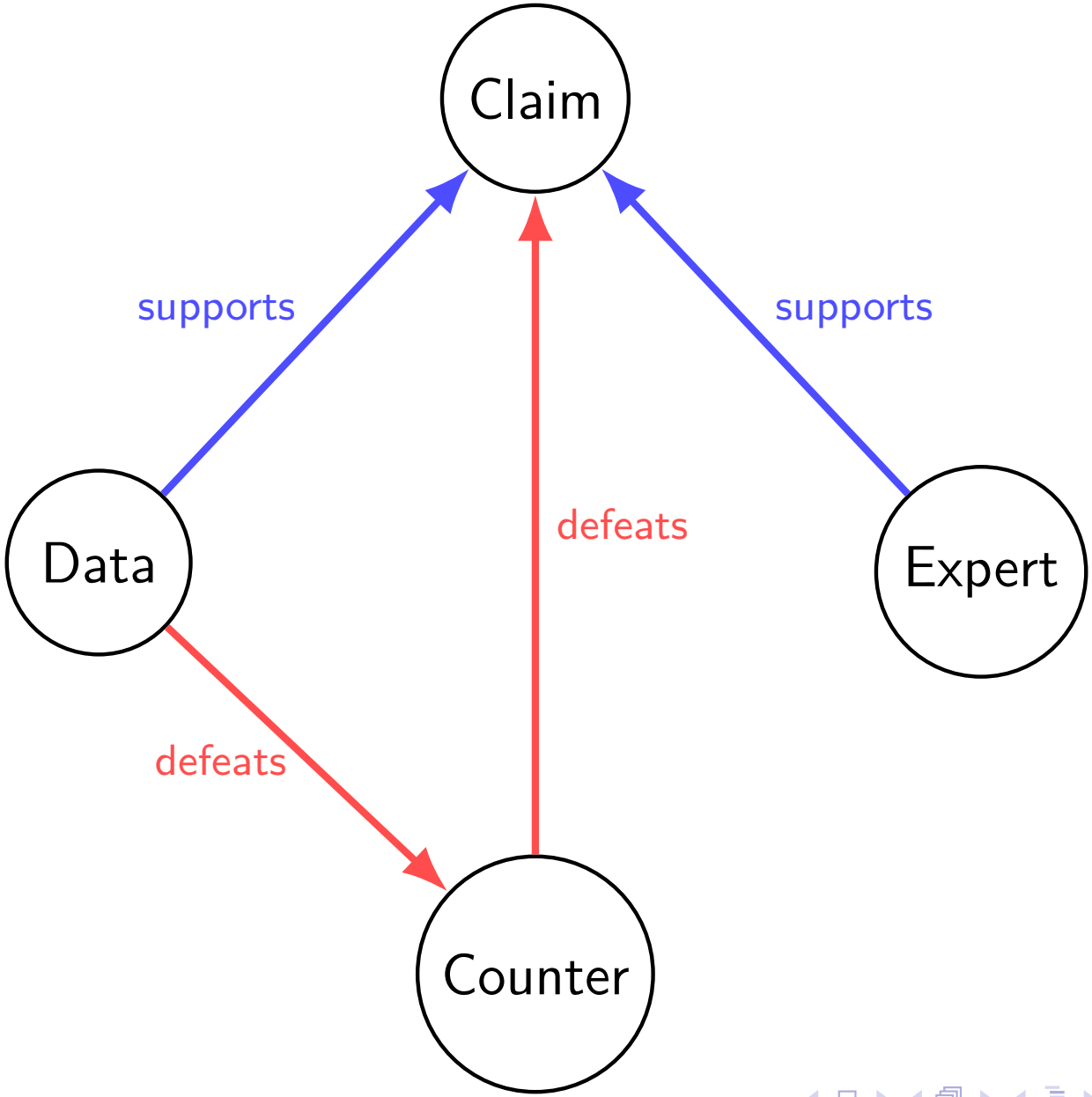


Figure: Example of a DNF formula in the NNF language.

GPU Parallelization

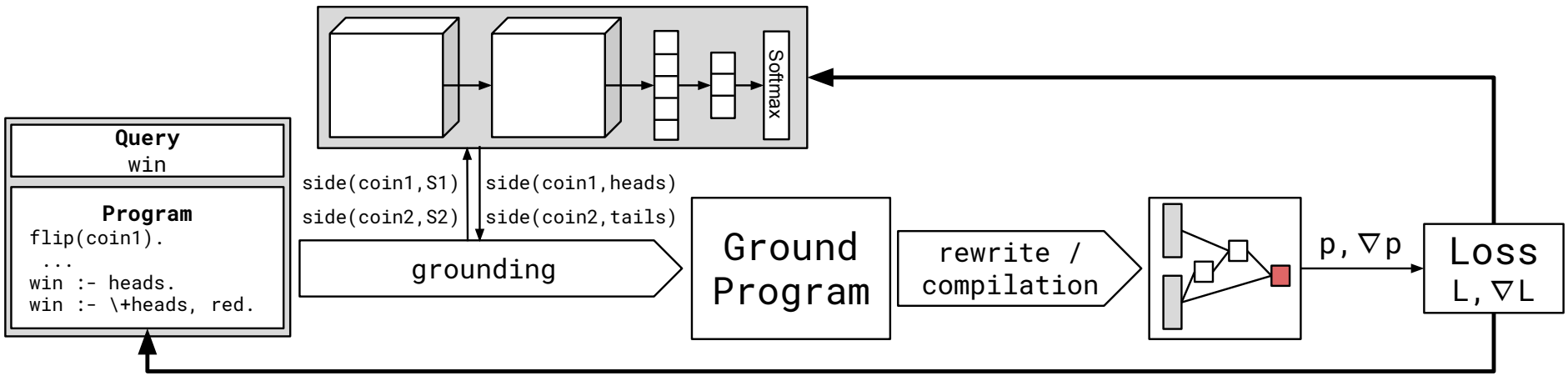


Bipolar Argumentation Frameworks (BAF)



Work Proposal

- Pose the problem of inference in PASP with Argumentation as a second-level Algebraic Model Counting (2AMC):
  - Compile a class of argumentation frameworks to Logic Circuits;
  - Convert the sd-DNNF circuitos into Arithmetic Circuits for efficient inference.
- Integrate the resulting circuit with auto-differentiation tools for end-to-end learning.



The End
Thank You!