Motivation

ASP allows us to encode information in the form of rules. Possibilistic ASP allows us to attach certainties to rules in an ASP normal program. Conclusions obtained from rules with low certainty are themselves of a low certainty, thus allowing us to order the conclusions based on how certain we are that the conclusions will hold in the real world.

However, existing approaches offer counter-intuitive results in certain cases. Consider the following problem:

We booked a ticket for an important concert. The concert is in Orlando, FL so we have a long drive time ahead of us, unless we find out that the concert is canceled. Some stranger tells us that the concert is canceled.

1: concertBooked ← 1: longDrive ← concertBooked, not canceled
0.2: canceled ←

Following the intuition that ‘not canceled’ means ‘it is not certain that canceled holds’, we propose semantics in which we slightly reduce the certainty of the conclusion ‘longDrive’ since we are little certain of the conclusion ‘canceled’. We thus do not discard the conclusion ‘longDrive’ as other approaches do.

These rules impose the following constraints on possibility distributions:

\[ N(\text{concertBooked}) \geq \min(N(\top), 1) \]
\[ N(\text{longDrive}) \geq \min(N(\text{concertBooked}), g(\text{canceled}), 1) \]
\[ N(\text{canceled}) \geq \min(N(\top), 0.2) \]

True (\(\top\)) is always entirely necessary, hence \(N(\top) = 1\). Using this info and since \(N(a) = 1 - \prod(\neg a)\) we can simplify these constraints as:

\[ \prod(\neg \text{concertBooked}) = 0 \]
\[ \prod(\neg \text{longDrive}) \leq 1 - g(\text{canceled}) \]
\[ \prod(\neg \text{canceled}) \leq 0.8 \]

There is only a single least specific possibility distribution that satisfies these constraints, namely the one where

\[ n(\{\text{concertBooked, longDrive, canceled}\}) = 1 \]
\[ n(\{\text{concertBooked, longDrive}\}) = 0.8 \]
\[ n(\{\text{concertBooked, canceled}\}) = 1 - g(\text{canceled}) \]
\[ n(\{\text{concertBooked}\}) = \min(0.8, 1 - g(\text{canceled})) \]
\[ n(\{\text{longDrive, canceled}\}) = n(\{\text{longDrive}\}) = n(\{\text{canceled}\}) = n(\{\}) = 0 \]

The final step is to determine for which choices \(g(\text{canceled}) = \prod(\neg \text{canceled})\):

\[ \prod(\neg \text{canceled}) = \max \{ n(I) | I | \neg \text{canceled} \} = 0.8 \]

As such, we obtain the following necessities:

\[ N(\text{concertBooked}) = 1 \]
\[ N(\text{longDrive}) = 0.8 \]
\[ N(\text{canceled}) = 0.2 \]

And thus the unique possibilistic answer set is of this program is

\{ concertBooked, longDrive, canceled \}

Main Results

1. We characterize answer sets of a classical answer set programming (ASP) normal program \(P\) as a set of constraints on possibilistic distributions. Each rule in \(P\) corresponds with a single constraint.
2. We naturally generalize these new semantics to possibilistic ASP.
3. We provide a syntactic counterpart, which is a possibilistic version of the Gelfond-Lifschitz reduct, allowing us to solve problems using current solvers.

For Further Information

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