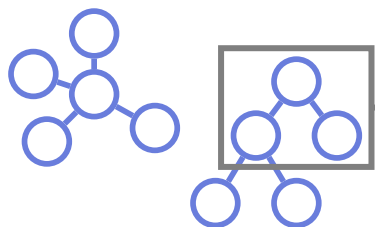


Hybrid Probabilistic Inference with Logical Constraints: Tractability and Message Passing

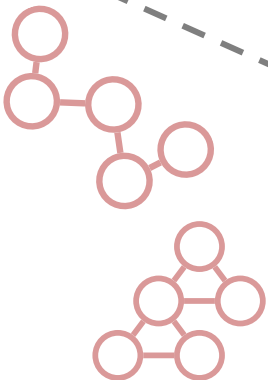
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1. Hardness: Treewidth & Diameter



Tractable:
Treewidth = 1 &
Diameter $O(\log n)$



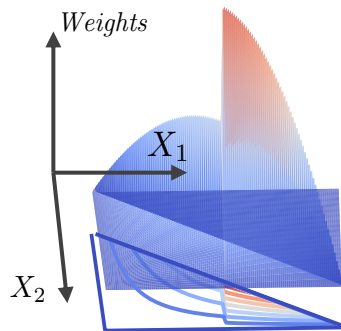
Intractable:
Treewidth > 1 or
Diameter in $O(n)$

2. Logical Constraints: Hybrid Domains, SMT(LRA)

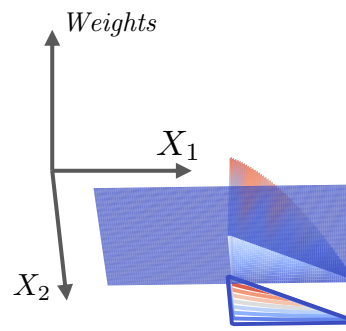
$$\begin{aligned} &0 \leq X_1 \leq 2 \\ &\wedge 0 \leq X_2 \leq 2 \\ &\wedge X_1 + X_2 \leq 2 \\ &\wedge B \vee (1 \leq X_1) \end{aligned}$$

+ weights

Regions of weighted satisfying assignments



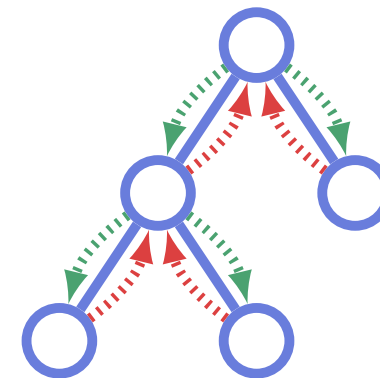
(I) $B = \top$



(II) $B = \perp$

3. Probabilistic Inference: Weighted Model Integration via Exact Message Passing

$$Pr(B) = \frac{WMI(I)}{WMI(I) + WMI(II)}$$



Up-/Down-ward Messages
in piecewise polynomial

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