# What is an Explanation in AnsProlog

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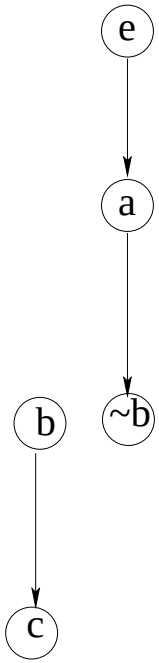
February 10, 2005

# Explanation in Prolog, Datalog




Explanation of $\{e\}$: Proof tree

$e \leftarrow a$

$a \leftarrow \text{not}\, b$

$b \leftarrow c$

There is no loop in the proof process

# Explanation in Stratified Logic Program

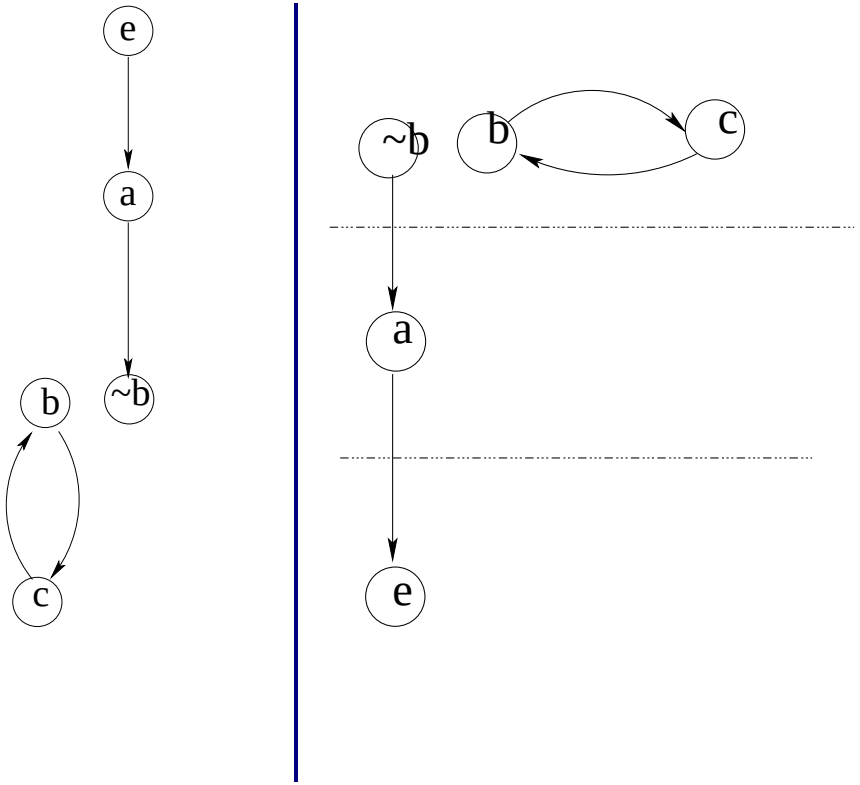
A stratified logic program (A logic program without negative loop

$e \leftarrow a$

$a \leftarrow \text{not}\, b$

$b \leftarrow c$

$c \leftarrow b$




There are loops, we need level-by-level proof tree

# What is the Explanation in Normal Logic Program (AnsProlog)?

- In the proof tree, we can always rank the atoms

$$
\begin{aligned}
a &\leftarrow \text{not } b \\
b &\leftarrow \text{not } a \\
a &\leftarrow a \\
c &\leftarrow a \\
c &\leftarrow \text{not } c
\end{aligned}
$$

- Stable model of the program: $\{a, c\}$.
- We want the explanation of $\{a, c\}$ to be

$$a \leftarrow \text{not } b$$
$$c \leftarrow a$$

# Definition: The Explanation of a Stable Model

A set of rules $Q$ is a explanation of a model $M$ in normal logic program $P$ if:

- There is a mapping $r : M \rightarrow Integer$ For each atom $a \in M$, there is a rule $r : a \leftarrow b_1, \cdots, b_m, \text{not}\, c_1, \cdots \text{not}\, c_n$ in $Q$ such that $r$ is satisfied by $M$ and $r(b_i) < r(a)$ $(1 \leq i \leq m)$

Proposition: $Q$ is an order-consistent program

# Finding Explanations of a Stable Model

- A explanation of a model $M$ can be found in polynomial time:

- Algorithm:

– Input: 1. $M = \{a, c\}$ 2.

$$
\begin{aligned}
a &\leftarrow \text{not}\, b \\
b &\leftarrow \text{not}\, a \\
a &\leftarrow a \\
c &\leftarrow a \\
c &\leftarrow \text{not}\, c
\end{aligned}
$$

– Step 1: Get a set of rules that are satisfied by $M$, and

with head in $M$.

$$
\begin{aligned}
a &\leftarrow \text{not } b \\
a &\leftarrow a \\
c &\leftarrow a
\end{aligned}
$$

– Step 2: It is a stratified logic program. Finding the fixpoint according to the level-by-level proof tree and assign the

## ranking

$$a \leftarrow \text{not } b$$

$$c \leftarrow a$$

# More related Problems

- Finding the explanation of any set of atoms
- Finding a partial explanation of a set of atoms if the program is inconsistent

# Explanation of a Set of Atoms

- Finding the explanation of $M = \{a\}$ in program

$$
\begin{aligned}
a &\leftarrow \text{not}\, b \\
b &\leftarrow \text{not}\, a \\
a &\leftarrow a \\
c &\leftarrow a \\
c &\leftarrow \text{not}\, c
\end{aligned}
$$

- We want the explanation to be $\{a \leftarrow \text{not}\, b\}$.
- We can treat it equally as finding the explanation of $\{a, c\}$: Finding the explanation of an answer set $N$, such that $N \supseteq M$.
- We may not need rules about $\{c\}$
- Approach:
  - Find the explanation of $N$ and postprocessing by removing nodes in the bottom part of the proof tree [The complexity of finding an answer set]
  - directly

- Definition: Program $Q$ is an explanation of a set of atoms $M$ in a normal logic program $P$ if $Q \subseteq P$, $M$ is an answer set of $P$, each answer set of $Q$ is a subset of an answer set of $P$, and $Q$ is a minimal program satisfying these conditions.

- More difficult than finding an explanation to an answer set

- The explanation is an order-consistent program

# Partial Explanation and Partial Stable Models

- Finding the explanation of $M = \{a\}$ in program

$$
\begin{aligned}
a &\leftarrow \text{not}\, b \\
b &\leftarrow \text{not}\, a \\
a &\leftarrow a \\
c &\leftarrow \text{not}\, c
\end{aligned}
$$

- The program has no stable models

- The inconsistenet is not related to the set $M$.
- Partial explanation

# Conclusions

- Explanation and partial explanation is useful in debugging a logic program
- They are useful in answer queries in a larger logic program. A larger program may inconsistent in one part. We can still answer queries that are not related to the inconsistences