

ARVis: Visualizing Relations between Answer Sets

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Motivation and Related Work

Improve answer set programming versatility:

- Tools for user support needed
- In particular tools with GUI

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Several existing tools that support visualization in context of ASP:

- ASPViz [Cliffe et al., 2008]
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- Kara (part of SeaLion) [Kloimüllner et al., 2011]
- ASPIDE [Febbraro et al., 2011]
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However, no system for visualization of *relations* between answer sets

Motivation and Related Work

Visualization of relations can be used for

- Expressing preference criterion
- Representation of results that build upon graph structure¹
- Debugging

¹see, e.g., work on argumentation [Charwat et al., 2012]

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We propose tool ARVis - “Answer Set Relationship Visualizer”



Key features:

- Problem and relations each expressed in an ASP encoding
- Results visualized as an interactive graph

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Case Study - Abduction

Goal: Find explanations for observed manifestations

Abduction

Problem (propositional case) consisting of

- background theory T of formulae over variables V ,
- manifestations M ,
- a set of hypotheses $H \subseteq V$.

Explanations E satisfying $E \subseteq H$ where

- $T \cup E$ is consistent
- and $T \cup E \models M$ holds.

Case Study - Abduction

Goals to be achieved with ARVis:

- 1 Provide possible explanations E for observed behavior
- 2 Relate all explanations E' , E'' wrt. to their “quality”

“Quality” can be expressed w.r.t. some criteria [Eiter and Gottlob, 1995]

- Subsets, i.e. $E' \subset E''$
- Cardinality, i.e. $|E'| < |E''|$
- Weights of hypotheses
- Priorities of individual hypotheses

Case Study - Abduction

Example

We see that the kids are playing outside (M):

$$M = \{\text{play outside}\}$$

$$T = \{\text{homework finished} \rightarrow \text{want to relax,} \\ \text{got new toy} \rightarrow \text{want to play,} \\ \text{not raining} \wedge \text{want to play} \rightarrow \text{play outside,} \\ \text{sunny} \wedge \text{want to relax} \rightarrow \text{play outside}\}$$

$$H = \{\text{sunny, got new toy, not raining, homework finished}\}$$

$$V = \{\text{sunny, homework finished, got new toy,} \\ \text{want to play, not raining,} \\ \text{want to relax, play outside}\}$$

Case Study - Abduction

- 1 ASP Program 1 derives all possible explanations E .
- 2 ASP Program 2 relates the explanations w.r.t. different preferences.

Example

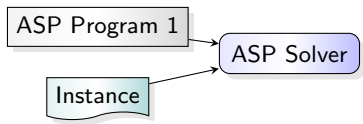
Explanations provided by Program 1:

$$\begin{aligned}
 E_1 : & \quad \{\text{not raining, got new toy, sunny}\} \\
 E_2 : & \quad \{\text{not raining, got new toy}\} \\
 & \quad \vdots \\
 E_7 : & \quad \{\text{sunny, homework finished}\}
 \end{aligned}$$

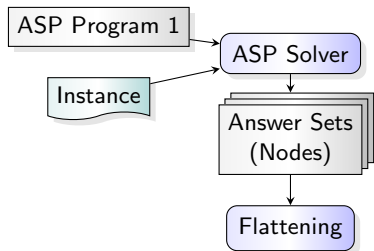
Relations provided by Program 2:

$$\begin{aligned}
 \text{Subset:} & \quad \{E_2 \subset E_1, E_7 \not\subset E_1, \dots\} \\
 \text{Cardinality:} & \quad \{|E_2| < |E_1|, |E_7| < |E_1|, \dots\}
 \end{aligned}$$

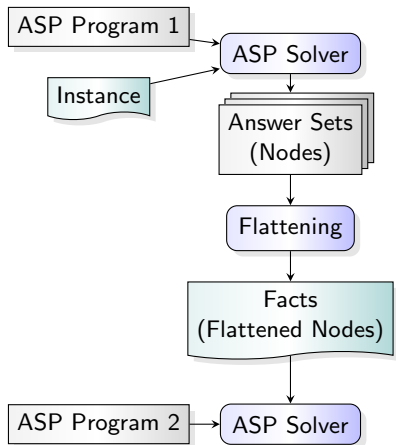
ARVis - Conceptual Design



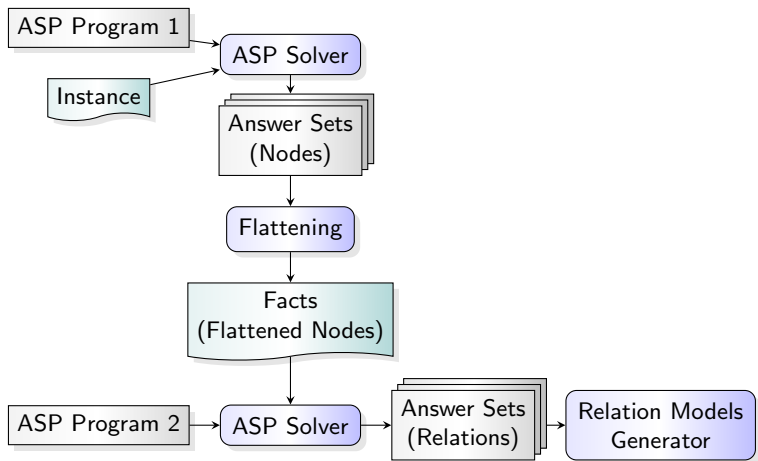
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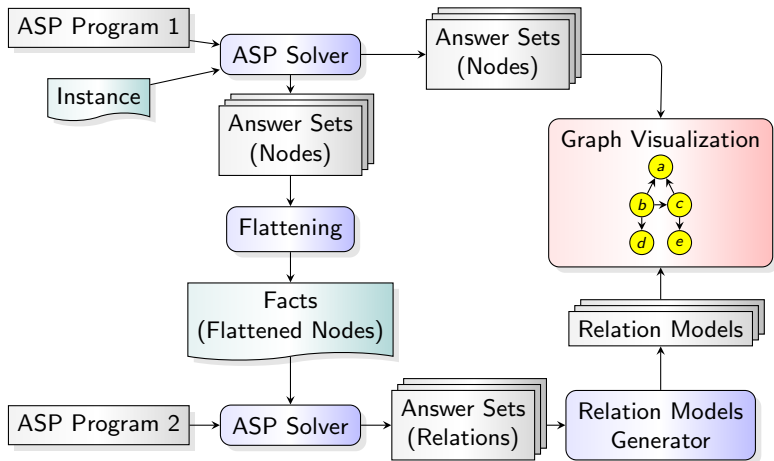
ARVis - Conceptual Design



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ARVis - Conceptual Design



ARVis Answer Set Relationship Visualizer

ARVis ASP Program 1 (Nodes) Flattening ASP Program 2 (Relations) Edge Selection Visualization

Graph model:

- Model 1
- Model 2
- Model 3
- Model 4
- Model 5
- Model 6
- Model 7
- Model 8
- Model 9
- Model 10

Graph Visualization:

```

graph TD
    2((2)) --> 1((1))
    2((2)) --> 4((4))
    1((1)) --> 3((3))
    4((4)) --> 3((3))
    5((5)) --> 3((3))
    6((6)) --> 3((3))
    5((5)) --> 6((6))
    7((7)) --> 5((5))
  
```

Layout graph by: KK FR

Filter predicates:

- hypothesis
- manifestation
- solution
- variable

Answer sets (for selected nodes):

Answer: 1
 solution("it's not raining"). solution("kids got a new toy"). solution("sunny day").

Answer: 2
 solution("it's not raining"). solution("kids got a new toy").

Answer: 7
 solution("kids finished their homework"). solution("sunny day").

Export Graph Export Results

Back Finish Cancel

ARVis – System Facts and Conclusion

System facts:

- Platform-independent – Implemented in Java, using Jung library
- Broad solver support – Support for Potassco family and DLV
- Domain-independent – Problems solely specified in ASP
- Performant – Handles 100s of nodes with 1000s of relations

Application areas:

- Any problem where preferences between solutions are relevant
- Problem domains with an underlying graph structure



<http://www.dbai.tuwien.ac.at/proj/arvis/>

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