Axiomatizing $\mathcal{EL}^{\bot}_{\text{gfp}}$-General Concept Inclusions in the Presence of Untrusted Examples

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Goal

Use description logic ontologies to represent knowledge of certain domains

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Problem

How to obtain these ontologies?

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Approach

Learn ontologies from domain data

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Problem

How to obtain these ontologies?

Approach

Learn first versions of ontologies from domain data

Goal

Extract terminological knowledge from factual knowledge.

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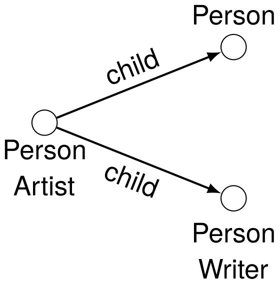

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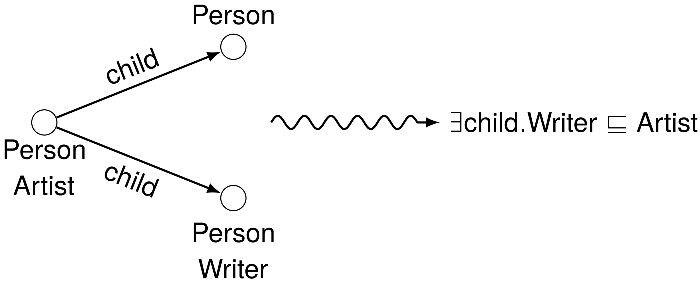
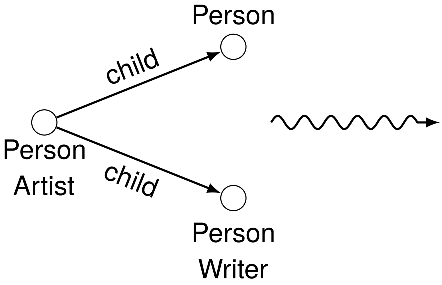
Extract terminological knowledge from factual knowledge.



Goal

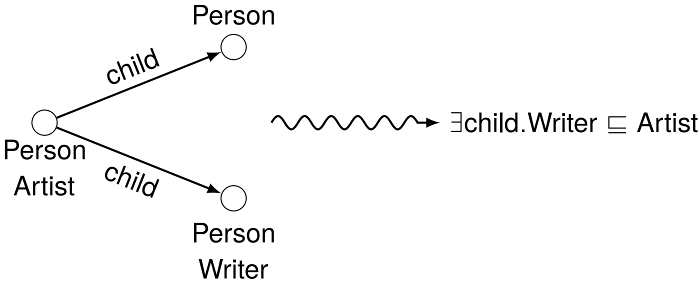
Extract terminological knowledge from interpretations.

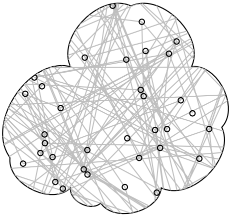


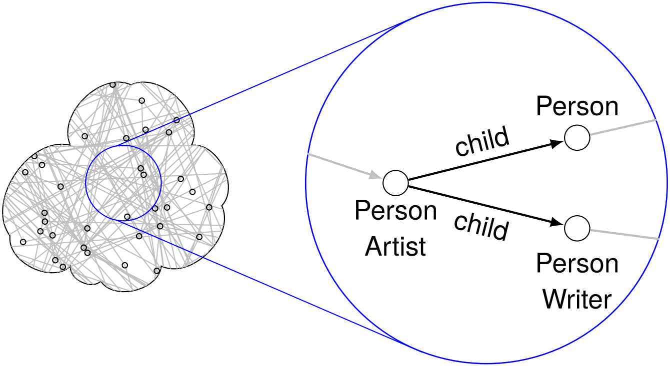
$\exists$child.Writer $\sqsubseteq$ Artist

Goal

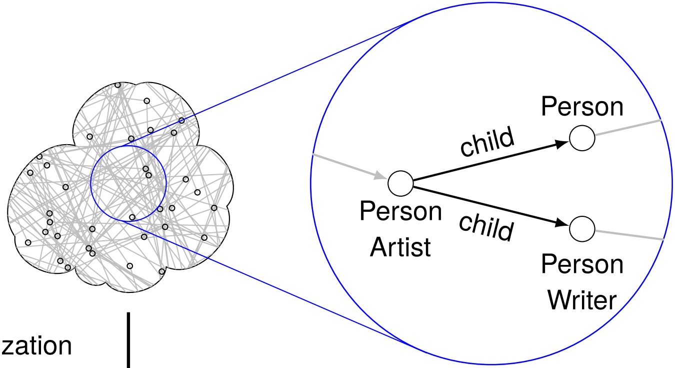
Extract finite bases of GCIs from interpretations.





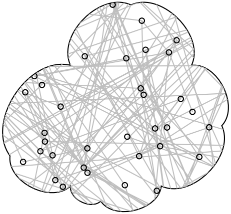


Person
child
Person
Artist
child
Person
Writer



Axiomatization
(Base of valid GCIs)

$\{\ldots, \exists \text{child}.\text{Writer} \sqsubseteq \text{Artist}, \ldots\}$



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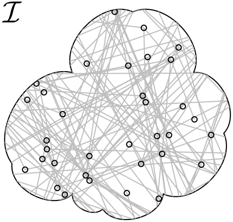
$\mathcal{I}$



$\mathbb{K}_{\mathcal{I}}$	$M_{\mathcal{I}}$		
$\Delta^{\mathcal{I}}$	×	×	.
	×	.	×
	.	.	×

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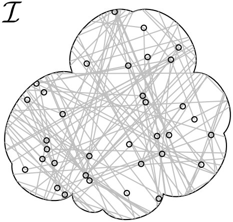

→

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Axiomatization (Base of valid Implications) ↓

$\{\, U \to V \mid \ldots \}$

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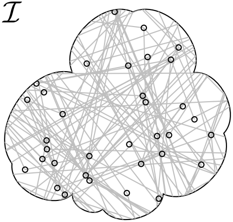

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Experiment

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- DBpedia, child-relation $\rightsquigarrow \mathcal{I}_{\text{DBpedia}}$

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- $\Delta^{\mathcal{I}_{\text{DBpedia}}} = 5626$, size of base 1252

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$$\text{Criminal} \sqsubseteq \text{Person}$$

$$\text{Criminal} \sqcap \exists \text{child}.\text{Politician} \sqsubseteq \bot$$

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$$\mathsf{conf}_{\mathcal{I}_{\text{DBpedia}}}(\exists \mathsf{child}.\top \sqsubseteq \mathsf{Person}) = \frac{2547}{2551}$$

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Definition

The *confidence* of $C \sqsubseteq D$ in $\mathcal{I}$ is defined as

$$\mathsf{conf}_{\mathcal{I}}(C \sqsubseteq D) := \begin{cases} 1 & \text{if } C^{\mathcal{I}} = \emptyset, \\ \frac{|(C \sqcap D)^{\mathcal{I}}|}{|C^{\mathcal{I}}|} & \text{otherwise.} \end{cases}$$

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Consider GCIs *with high confidence* in the data

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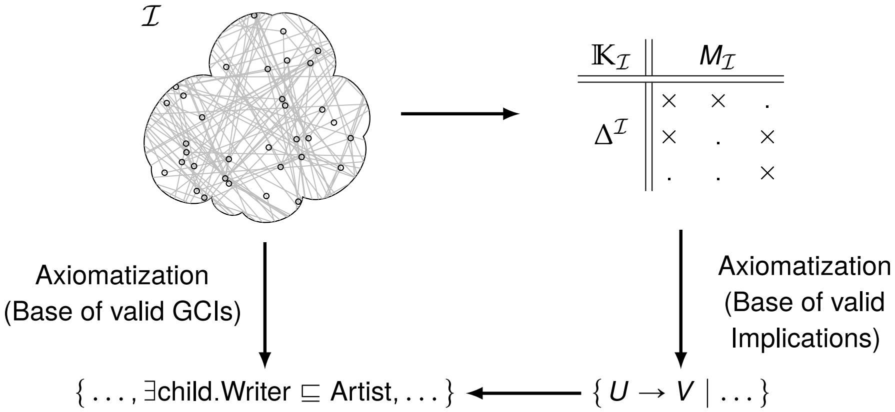
Approach

Consider GCIs *with high confidence* in the data, i. e. compute *finite bases* of $\mathrm{Th}_c(\mathcal{I})$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$\mathbb{K}_{\mathcal{I}}$
$M_{\mathcal{I}}$
$\Delta^{\mathcal{I}}$
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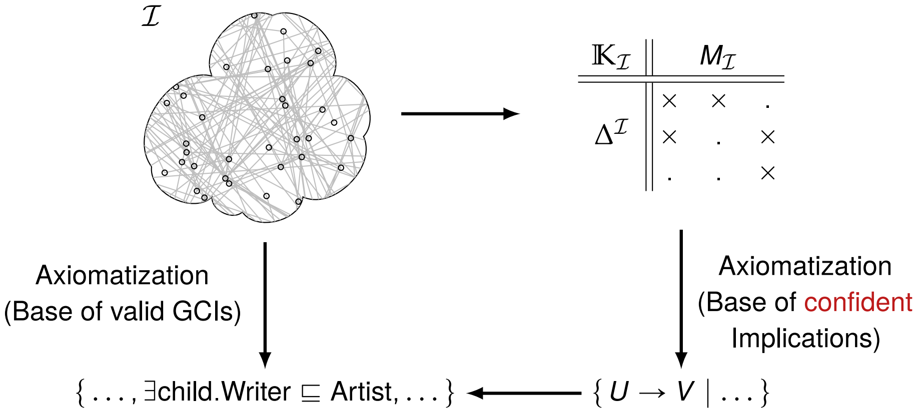
$\{U \to V \mid \ldots\}$



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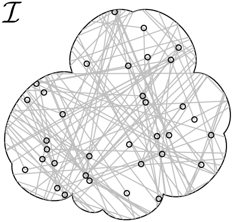

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	×	×	.
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	.	.	×

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All individuals are suspected to be erroneous

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Distinguish between *trusted* and *untrusted* individuals

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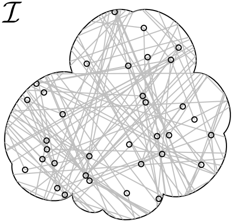
Definition

$$\mathrm{Th}_c(\mathcal{I}, \mathcal{J}) := \{\, C \sqsubseteq D \mid C^{\mathcal{I}} \setminus \Delta^{\mathcal{J}} \subseteq D^{\mathcal{I}} \setminus \Delta^{\mathcal{J}}, \\ |(C \sqcap D)^{\mathcal{I}} \cap \Delta^{\mathcal{J}}| \geqslant c \cdot |C^{\mathcal{I}} \cap \Delta^{\mathcal{J}}| \,\}$$

$\mathcal{I}$



→

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	×	.	×
	.	.	×

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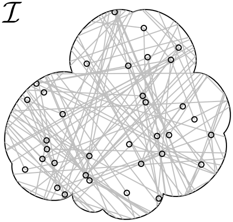
$\mathcal{I}$



$\mathbb{K}_{\mathcal{I}}$	$M_{\mathcal{I}}$
$\Delta^{\mathcal{I}} \setminus \Delta^{\mathcal{J}}$	trusted
$\Delta^{\mathcal{J}}$	untrusted

Axiomatization (Base of confident GCIs)

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$\{ \dots, \exists \text{child.Writer} \sqsubseteq \text{Artist}, \dots \} \longleftarrow \{ U \to V \mid \dots \}$

Theorem

Let

$$\mathsf{Conf}(\mathcal{I}, c, \mathcal{J}) = \{\, (C^{\mathcal{I}})^{\mathcal{I}} \sqsubseteq (D^{\mathcal{I}})^{\mathcal{I}} \mid (C \sqsubseteq D) \in \mathsf{Th}_c(\mathcal{I}, \mathcal{J}) \,\}.$$

Theorem

Let

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If then $\mathcal{B}$ *is a finite base of* $\mathsf{Th}(\mathcal{I})$*, then the set*

$$\mathcal{B} \cup \mathsf{Conf}(\mathcal{I}, c, \mathcal{J})$$

is a finite base of $\mathsf{Th}_c(\mathcal{I}, \mathcal{J})$*.*

Summary

- Extended approach by Baader and Distel to setting of *trusted* and *untrusted* individuals
- Provided effective methods to computes bases in this setting

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- *Attribute Exploration*

Thank You