

Causation, Ontology and Reasoning

A Tutorial on Axiom Extraction

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Our Idea

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Our Idea

What is Ontology

Gruber[1993] defined as:

a formal, explicit specification of a shared conceptualisation.

What is Ontology (cont.)

Usually an ontology would have

- ▶ terms

sheep

- ▶ concepts

herbivore

- ▶ taxonomic relations

isA(sheep,herbivore)

- ▶ non-taxonomic relations

eats(sheep,grass)

- ▶ axioms (rules)

eats(A,grass) :- isA(A,herbivore)

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Is it useful?

Serves as domain-specific expert systems

- ▶ Knowledge is given manually in most cases
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Ontology learning

Can be classified into two types

Lightweight, informal ontologies

→ glossaries, data dictionaries, Thesauri and *etc.*

Heavyweight, formal ontologies

→ description logics, formal taxonomies, general logics and *etc.*

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Prerequisite Knowledge

Horn Clauses

$$h \leftarrow p_1, p_2, p_3 \dots$$

meaning: if $p_1, p_2, p_3 \dots$, then h

In Prolog, it looks like $h :- p_1, p_2, p_3 \dots$

$h, p_1 \dots$ should be predicates (facts or relations), like $male(obama)$ or $isPresident(obama, america)$

It should be noted that this is called Horn Clause Logic, and it's not necessarily the only logic to represent axioms.

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Related Works

In a specific domain (legal systems), extract rules by templates

must(--, *permits*(--, --)) \leftarrow *coveredEntity*(--), *coveredUnder*(--), *isPHI*(--).

However, when we are faced with Web, this method won't work.

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Related Works (cont.)

And in AI field,

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- ▶ Inductive Logic Programming as Machine Learning approach

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Inductive Logic Programming

Rules are derived from existing collection of concepts and relations which are divided into positive and negative examples.

tigers have fur

cats have fur

felines have fur

dogs have fur

mammals have fur

humans do not have fur

canines and felines have fur

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Inductive Logic Programming (cont.)

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eat(zebra, grass)
is-a(zebra, herbivore)
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will arrive at the conclusion

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Some ideas and... call for help!

Causation could define axioms effectively

e.g. If someone drinks cyanide (a kind of poison), he/she would die.

This sentence could be interpreted as

die(human) : \neg drink(human, cyanide)

Extracting **predicates** is different from extracting relations, thus can be more difficult. Furthermore, sentence patterns expressing causal relations may vary

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Consider this sentence.

Cyanide kills humanbeings.

The relation would be *kills(human,cyanide)*.

Can we turn the noun phrases into predicates?

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