Title: Abduction
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Abduction

Synonyms

Definition

Abduction is the task of finding an explanation for an observation with respect to given knowledge.

Characteristics

The key principle underlying abduction is that of hypothesizing a set of facts that, together with the available knowledge, explain a specific observation. For instance, given background knowledge about flying and non-flying objects, including a rule stating that normal birds fly ($\forall x. \text{bird}(x) \wedge \text{normal}(x) \rightarrow \text{flies}(x)$), the observation that Tweety flies ($\text{flies}(\text{tweety})$) can be explained by abducting that Tweety is a normal bird ($\{\text{bird}(\text{tweety}), \text{normal}(\text{tweety})\}$).

More formally, given background knowledge B , a set A of abducibles (i.e., facts that can be part of explanations), and a ground fact or observation o , the task of abduction is to find an explanation for o , that is, a set of facts $E \subseteq A$ such that o can be inferred from $B \cup E$ using [deduction](#).

Similarly to [induction](#), abduction can be seen as a form of inverted [deduction](#). However, whereas induction finds general rules from several examples, abduction as-

sumes these rules to be part of the background knowledge and instead finds ground facts explaining a single example. The principle of abduction goes back to the philosopher and logician Charles Sanders Peirce, who viewed it as the part of scientific methodology seeking explanations that turn surprising observations into plausible consequences of an existing theory.

In the context of Bayesian networks, finding the most probable explanation (MPE), that is, the most likely values of all non-observed variables given observed values for a subset of variables, is sometimes also considered abductive inference. A similar idea, albeit in the context of a first order logic language and with a clear distinction between abducibles and the rest of the theory, is used in probabilistic horn abduction (PHA) (Poole 1993). PHA associates probabilities to abducibles, thus allowing one to choose explanations based on their probabilities. In abductive logic programming (Kakas et al. 1992), integrity constraints are used to restrict the set of possible explanations.

Cross-references

- induction
- deduction

References

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- Kakas AC, Kowalski RA, Toni F (1992) Abductive logic programming. *J. Log. Comput.* 2(6):719–770.
- Poole D (1993) Probabilistic Horn abduction and Bayesian networks. *Artificial Intelligence* 64:81–129.