Relaxed Abduction

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Robust Information Interpretation for Industrial Applications

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Preface

Automated information interpretation is gaining momentum in industrial applications. One of the major challenges in this context is the appropriate treatment of incompleteness of both the observations about the world, and the domain model formalizing it. This dissertation proposes a novel approach called "Relaxed Abduction", which is able to provide reasonable interpretations even if it would not be possible or extremely complex to explain all observations made. The approach is based on the idea of treating explanatory power and consilience of an interpretation bi-criterially instead of mapping them onto a one-dimensional scale. Based on a formalization of the proposed approach, the thesis investigates concrete instantiations and their properties (particularly runtime complexity), and proposes an extension which allows to handle incoming changes in the underlying data incrementally. Two algorithms for solving relaxed abduction problems are proposed (one generic and one $\mathcal{EL}$-specific) and evaluated in a real-world use case, confirming the theoretical results in practice. Additionally, to close the gap between academic research and industrial applications, the thesis proposes a methodology to structure diagnosis problems according to ISO 13379 and express it by means of several description logic knowledge bases. The dissertation results show that the proposed, flexible notion of abduction is indeed novel, relevant for industry, and permits practical usage. Future steps required to bring relaxed abduction into application are identified.

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