Accommodative Belief Revision

Satu Eloranta¹, Raul Hakli², Olli Niinivaara¹, and Matti Nykänen³

¹ Department of Computer Science
P.O. Box 68 (Gustaf Hällströmin katu 2b)
FIN-00014 University of Helsinki, Finland
² Department of Philosophy
P.O. Box 9 (Siltavuorenkampi 20 A)
FIN-00014 University of Helsinki, Finland
³ University of Kuopio
Department of Computer Science
P.O. Box 1627
FIN-70211 Kuopio, Finland
firstname.lastname@cs.helsinki.fi
matti.nykanen@cs.uku.fi

Abstract. Accommodative revision is a novel method of non-prioritized belief revision. The epistemic state of an agent contains both knowledge that is immune to revision and beliefs that are allowed to change. Incoming information is first revised by the knowledge of the agent, and then the epistemic state of the agent is revised using this modified input. The properties of the method are studied and examples of its use are given.

Keywords: belief change, belief revision, non-prioritized belief revision, integrity constraints, knowledge.

1 Introduction

In belief revision, an agent obtains new information about a static world. On one hand, the input may be considered as the most recent and as such the most reliable piece of information. In that case, if the new information contradicts the beliefs of the agent, it needs to give up some of the old beliefs in order to maintain consistency of beliefs [1]. However, this framework, called prioritized belief revision, allows even self-contradictory input to be accepted into the beliefs of the agent.

On the other hand, in non-prioritized belief revision (see [16] for a survey) the input is not necessarily accepted. The agent may have some information that it will refuse to give up at any situation. In computer science such information might be called integrity constraints [22], in philosophy knowledge [17]. In belief revision literature the term core beliefs has also been used [16].

Instead of rejecting the input that the agent knows to be impossible, we aim to find a charitable interpretation that retains as much as possible of the input. For instance, suppose that we hear that “Jaakko Kuusisto, a winner of the Sibelius violin contest, gives a concert at the forthcoming open air music festival”. However, we know for a fact that although Jaakko has participated in the contest as well, it is actually his brother...
Pekka who has managed to win it. Our natural reaction would be to think that “the speaker must have got either the first name or the bit about the contest victory wrong. But there will be a concert by either of the two brothers, that much I can believe now”.

The amount of information obtained from an “unbelievable input” may vary. Let us consider a modification of an example by Hansson [15]. Amy tells the agent that she saw a three-toed woodpecker with a red forehead and a red rump just outside her window. When it comes to birds, the agent has more knowledge than Amy: The agent knows that a three-toed woodpecker neither has a red forehead nor a red rump. The agent has various possibilities when making sense of the impossible statement. With some benevolence, it can come to one of the following conclusions: (1) Amy saw a bird with a red forehead and a red rump, but it was not a three-toed woodpecker, (2) Amy saw a bird with a red forehead and a red rump or Amy saw a three-toed woodpecker (but not one with a red forehead or a red rump), or (3) at least Amy saw some kind of a bird outside her window.

In this paper, we introduce *accommodative revision*, a method for non-prioritized belief revision. The basic idea is to use knowledge as a filter that the incoming information has to pass through before the epistemic state can be revised. The agent will modify the input to accord with its knowledge.

Our proposal has the following properties: (1) input inconsistent with knowledge will not be accepted, but the input will be modified to produce an acceptable formula prior to revising the epistemic state, (2) only knowledge is used to modify the input, and (3) the modification of the input and the revision of the epistemic state are performed as two separate phases. We will also describe an implementation that is publicly available to allow small-scale experimentation of our proposal.

In our two-phase revision, at first the input is revised by the knowledge of the agent, giving a new input formula. Then the epistemic state of the agent is revised by the new formula. Thus our proposal is closely related to selective revision [12] and might be considered as a generalization of the revision method presented in [2] (see Sect. 3 for comparison). Other, more recent non-prioritized belief revision proposals based on the modification of input sentence do also exist, e.g. [5], [20] and [3], but they are based on syntactic manipulation whereas our method uses previously defined (semantically-oriented) belief-revision operators already known to satisfy certain principles.

The outline of the paper is as follows. Section 2 recalls the basic ideas of belief revision. In Sect. 3 we give the definition of our method, and in Sect. 4 we study its properties. In Sect. 5 we introduce an implementation of accommodative revision with various sample operators. In Sect. 6 we analyze some examples. Section 7 is devoted for conclusions.

## 2 Preliminaries

In belief revision, an agent evolves its epistemic state due to incoming information called epistemic input. At first the input is classified, and the way the epistemic state will be changed depends on the result of the classification. On the meta level, the change is guarded by rationality criteria. Alchourrón, Gärdenfors and Makinson [11] have proposed a set of principles for belief revision known as the *AGM-postulates*. Darwiche