A New Definition of Non-monotonic Inference

Nicholas Asher & Yi Mao

In this paper, we introduce two notions of nonmonotonic reasoning: the syntactic notion of Reasonable Consequence $\mid\!\sim$ and the semantic notion of Reasonable Entailment $\models\!\!\approx$. We prove that one is sound and complete relative to the other. There are two layers involved in the definition of $\mid\!\sim$: at the bottom is a propositional modal conditional logic which allows unlimited nesting of defaults and embedding into any context analyzable in possible-worlds semantics. The notion of derivibility $\vdash$ for this level is the classical one. $\mid\!\sim$ is built on the top of this system via transforming as many formulas of the form $(A > B)$ as possible into those of the form $\Box(A \to B)$, and $\neg(A > B)$ into $(\Box A \to \neg\Box B)$ while preserving consistency relative to $\vdash$. $\Gamma \mid\!\sim \phi$ iff $\Gamma \vdash \phi$ for all maximal transformations of Γ.

This approach of defining $\mid\!\sim$ offers four advantages: First, it nicely handles negated defaults of the form $\neg(A > B)$, to which researchers have not paid much attention but which are important for analyzing various pragmatic phenomena like lexical blocking. Second, thus defined $\mid\!\sim$ captures nonmonotonic argument patterns familiar from the artificial intelligence literature such as Defeasible Modus Ponens, Nixon Diamond and all those satisfied by Asher & Morreau (1991). In addition, $\mid\!\sim$ is Cumulative. Third, $\mid\!\sim$, unlike the inference notion in Default Logic and many other systems of nonmonotonic inference, is insensitive to the order in which premises are considered; although each maximal transformation is order sensitive, the consideration of all possible maximal transformations cancels out the order sensitivity of $\mid\!\sim$. There is no extraneous ordering imposed in determining whether $\mid\!\sim$ holds between a set of premises and a conclusion. Fourth, compared with the Commensense Entailment notion discussed in Asher & Morreau [1991], the present account is technically simpler. So it provides a better foundation for analyses which depend on nonmonotonic reasoning such as generics (Pelletier & Asher [1997]), common sense obligation (Asher & Bonevac [1997]), and discourse interpretation (Lascarides & Asher [1993]).

Asher, N. and Bonevac, D.: 1997, "Common sense obligation", in D. Nute(ed.), *Defeasible Denotic Logic*, Kluwer Academic Publishers.

Asher, N. and Morreau, M.: 1991, "Commonsense entailment: A modal theory of nonmonotonic reasoning", in J.Mylopoulos and R.Reiter(eds.), *Proceedings of the Twelfth International Joint Conference on Artificial Intelligence.*

Lascarides, A. and Asher, N,: 1993, "Temporal interpretation, discourse relations and commonsense entailment", *Linguistics and Philosophy 16.*

Pelletier, F. J. and Asher, N.: 1997, "Generics and defaults", in J.van Benthem and A. ter Meulen(eds.), *Handbook of Logic and Language*, North Holland.

Addresses
Nicholas Asher: Department of Philosophy, University of Texas at Austin, USA
E-mail: `nasher@mail.la.utexas.edu`

Yi Mao : Department of Philosophy, University of Texas at Austin, USA
E-mail: `maoyi@mail.utexas.edu`