On the Complexity of Enumerating Prime Implicants from Decision-DNNF Circuits

Alexis de Colnet[1] **and Pierre Marquis**[1,2]

[1] Univ. Artois, CNRS, Centre de Recherche en Informatique de Lens (CRIL), F-62300 Lens, France
[2] Institut Universitaire de France
{decolnet, marquis}@cril.fr

Abstract

We consider the problem Enum·*IP* of enumerating prime implicants of Boolean functions represented by decision decomposable negation normal form (dec-DNNF) circuits. We study Enum·*IP* from dec-DNNF within the framework of enumeration complexity and prove that it is in OutputP, the class of output polynomial enumeration problems, and more precisely in IncP, the class of polynomial incremental time enumeration problems. We then consider closely related problems where further restrictions are put on the prime implicants to be generated, especially the enumeration of abductive explanations and the enumeration of sufficient reasons. Abduction is a well-studied form of nonmonotonic reasoning allowing one to generate explanations for certain symptoms or manifestations. Abductive explanations are also connected to several reasoning settings developed in AI, including assumption-based reasoning and closed-world reasoning. Sufficient reasons are explanations about predictions from machine learning classifiers. They are a key notion in the emerging field of formal explainable AI. We investigate the extent to which the complexity of enumerating the specific prime implicants corresponding to abductive explanations and to sufficient reasons differs from the general case.