

Witnessed Symmetric Choice and Interpretations in Fixed-Point Logic with Counting

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Abstract: At the core of the quest for a logic for PTime is a mismatch between algorithms making arbitrary choices and isomorphism-invariant logics. One approach to tackle this problem is witnessed symmetric choice. It allows for choices from definable orbits certified by definable witnessing automorphisms.

We consider the extension of fixed-point logic with counting (IFPC) with witnessed symmetric choice (IFPC+WSC) and a further extension with an interpretation operator (IFPC+WSC+I). The latter operator evaluates a subformula in the structure defined by an interpretation.

When similarly extending pure fixed-point logic (IFP), IFP+WSC+I simulates counting which IFP+WSC fails to do. For IFPC+WSC, it is unknown whether the interpretation operator increases expressiveness and thus allows studying the relation between WSC and interpretations beyond counting.

In this paper, we separate IFPC+WSC from IFPC+WSC+I by showing that IFPC+WSC is not closed under FO-interpretations. By the same argument, we answer an open question of Dawar and Richerby regarding non-witnessed symmetric choice in IFP.

Additionally, we prove that nesting WSC-operators increases the expressiveness using the so-called CFI graphs. We show that if IFPC+WSC+I canonizes a particular class of base graphs, then it also canonizes the corresponding CFI graphs.

This differs from various other logics, where CFI graphs provide difficult instances.

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