Model Checking for Combined Temporal Logics

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Concerns about modularity and the wish to join together different kinds of information have inspired various combinations of logics. As any interesting real-world system is a complex entity, decomposing its descriptive and inferential requirements for design, verification, or maintenance purposes into simpler reasoning tasks is often the only plausible way forward [7]. Assuming that we have methods and tools available to tackle restricted tasks, how do we combine them to solve complex tasks? In particular, how do we combine them in such a way that features of the components are inherited by the combination? This question is known as the *transfer problem* [1]. Whether properties transfer from the components to the combination depends on the amount of interaction between the component logics; even in the presence of very weak forms of interaction (such as shared symbols), transfer may fail [9]. In the absence of interaction between the component logics, we often have transfer; such positive results are usually based on a *divide and conquer* strategy: split problems into sub-problems and delegate these to the components [4, 10].

From a *computational* point of view, the natural question in the setting of combining logics is: does it work? Can we *re-use* tools and procedures in a modular fashion? So far, most of the work towards answering this question has gone into putting together deductive engines. While there are no uniform solutions, there are many successful instances of combined proof procedures, especially for modal and modal-like logics; these are often based on calculi satisfying special criteria or on translating the component logics into a background logic.

We studied the combination of model checking procedures [6]. Our motivation for studying model checking algorithms for combined logics comes from two concrete examples: *granular reactive systems* [11, 13] and *mobile agent systems* [2, 3, 12, 5]. We showed that both these formalisms can be captured in terms of various kinds of combinations of logics, viz. so-called temporalizations, joins, and independent combinations. This implies that model checking methods for them can be synthesized from suitable combinations of model checkers for simpler component logics. More generally, in contrast to combining deductive engines, combinations of model checking procedures are well behaved, even in the presence of interaction, thus supporting the general believe that modularity is easier to achieve in model checking than in theorem proving approaches [8].

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