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Linear temporal logic with until and next, logical consecutions. (English) Zbl 1147.03008
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Summary: While specifications and verifications of concurrent systems employ Linear Temporal Logic ($\mathcal{LTL}$), it is increasingly likely that logical consequence in $\mathcal{LTL}$ will be used in the description of computations and parallel reasoning. Our paper considers logical consequence in the standard $\mathcal{LTL}$ with temporal operations **U** (until) and **N** (next). The prime result is an algorithm recognizing consecutions admissible in $\mathcal{LTL}$, so we prove that $\mathcal{LTL}$ is decidable w.r.t. admissible inference rules. As a consequence we obtain algorithms verifying the validity of consecutions in $\mathcal{LTL}$ and solving the satisfiability problem. We start by a simple reduction of logical consecutions (inference rules) of $\mathcal{LTL}$ to equivalent ones in the reduced normal form (which have uniform structure and consist of formulas of temporal degree 1). Then we apply a semantic technique based on $\mathcal{LTL}$-Kripke structures with formula definable subsets. This yields necessary and sufficient conditions for a consecution to be not admissible in $\mathcal{LTL}$. These conditions lead to an algorithm which recognizes consecutions (rules) admissible in $\mathcal{LTL}$ by verifying the validity of consecutions in special finite Kripke structures of size square polynomial in reduced normal forms of the consecutions. As a consequence, this also solves the satisfiability problem for $\mathcal{LTL}$.

MSC:

03B44 Temporal logic
03B25 Decidability of theories and sets of sentences
03B70 Logic in computer science

Keywords:

algorithms; linear temporal logic; admissible consecutions; logical consequence; admissible inference rules; Kripke structures

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