How to prove equivalence of term rewriting systems without induction.

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A reduction system is a structure $R = (A, \rightarrow)$ consisting of a set $A$ and a binary relation $\rightarrow$ on $A$. A term rewriting system is a reduction system where $A$ is the set $T(F, V)$ of terms over a set $F$ of function symbols and a set $V$ of variables, and $\rightarrow$ is a set of rewrite rules $(l, r)$: $l \notin V$, and any variable in $r$ also occurs in $l$.

The author proposes a new simple method to establish the equivalence of two reduction systems with respect to a restricted domain. This method is not directly based on induction but uses reachability of reduction systems and the Church-Rosser property. A distinction is made between abstract properties of the reduction relation and properties depending on the term structure.

The author’s method extends earlier approaches and is not limited to term rewriting: it also applies to various other reduction systems (Thue systems, graph rewriting, $\lambda$-calculus). An application of this method’s equivalence-preserving transformations consists in proving the correctness of some program transformation rules.

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