Evaluation of Transaction Logic Programs

Master in Science, 1994

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Abstract

Transaction Logic ($\mathcal{T_R}$) extends first-order logic to account for the phenomenon of state changes in first-order theories. A fragment of $\mathcal{T_R}$, called Horn–$\mathcal{T_R}$, has advanced transaction specification and execution capabilities. Its functionality includes queries, updates, serial execution, and non-deterministic execution, integrated declaratively in the logic.

The contributions of this thesis are two-fold. First, we develop a fixpoint semantics for Horn–$\mathcal{T_R}$, and prove it to be equivalent to the model-theoretic semantics. Second, we investigate the evaluation of Horn–$\mathcal{T_R}$ programs. Taking a bottom-up approach, we devise an evaluation method based on the fixpoint semantics. We then propose a combination of rule-rewriting techniques for adding top-down control to this approach, enabling realistic execution of updates. Exploring top-down evaluation, we extend existing frameworks for top-down query processing to Horn–$\mathcal{T_R}$, and prove soundness and completeness results. Our work suggests that top-down evaluation is better suited to non-deterministic execution, and has great optimizations potential.