

Register Allocation by Proof Transformation*

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Abstract

This paper presents a proof-theoretical framework that accounts for the entire process of register allocation – liveness analysis is proof reconstruction (similar to type inference), and register allocation is proof transformation from a proof system with unrestricted variable accesses to a proof system with restricted variable access. In our framework, the set of registers acts as a “working set” of the live variables at each instruction step, which changes during the execution of the code. This eliminates the ad-hoc notion of “spilling”. The necessary memory-register moves are systematically incorporated in our proof transformation process. Its correctness is a direct corollary of our construction; the resulting proof is equivalent to the proof of the original code modulo treatment of structural rules. The framework yields a clean and powerful register allocation algorithm. The algorithm has been implemented, demonstrating the feasibility of the framework.

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