Sparse Analysis of Variable Path Predicates Based Upon CSSA-Form

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Abstract. Concurrent Static Single Assignment Form (CSSA-form) has been proposed as an intermediate representation for parallel programs supporting program analysis and optimization in the spirit of its sequential counterpart Static Single Assignment Form. A number of fundamental analysis and optimization techniques have already been defined for CSSA-form, like copy or constant propagation, each exploiting the properties of CSSA-form to enable a sparse analysis. In this paper, we enlarge this set of sparse analyses by a novel analysis technique for deriving variable path predicates as a predicate-based abstraction of a program's variables' values. We will in particular show, how the single assignment property of CSSA-form naturally facilitates the analysis sparseness in that it allows for the characterization of variables' values by predicates along the chain of data dependences for the variables' defining instructions, instead of using global program state. Furthermore, it enables the incorporation and derivation of path information in terms of set-based predicate encodings, in order to distinguish variables' values among different control flow paths. While the proof of correctness for the analysis of parallel programs is ongoing work, correctness in the sequential case is shown by defining an equivalent data flow analysis and proving its fit with the monotone data flow framework. The presented analysis has been implemented and applied to the generation of more accurate low-level models of parallel BPEL programs used for model checking.