Elimination-Based Data Flow Analysis for Variable Ranges

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This talk describes a program analysis technique for finding value ranges for variables in the LLVM assembly language. Range analysis has several important applications, including, elimination of assertions in programs, automatically deducing numerical stability, and eliminating array bounds checking. Determining value ranges poses a major challenge in program analysis because it is difficult to ensure the termination of the analysis in the presence of program cycles. Further, implementing state-of-the-art methods requires additional processing when the target language is unstructured (e.g. languages with `goto` statements).

In this work we demonstrates an approach where loops are detected intrinsically within the analysis. Our work combines methods of elimination-based data flow analysis with abstract interpretation. We have implemented a prototype of the proposed framework in the LLVM compiler framework as a program analysis pass and have conducted experiments with a suite of test programs to show the feasibility of our approach.