Implementation of Dominance-Based Duplication Simulation in LLVM

Kai Franz and Grey Golla

https://kai-franz.github.io/dbds/
The goal of this project is to implement a subset of the optimizations from “Dominance-Based Duplication Simulation (DBDS)” (https://dl.acm.org/doi/pdf/10.1145/3168811). The paper proposes a method to allow code to be moved from one block into multiple predecessor blocks to allow a variety of optimizations.

For our 75% goal, we will implement the DBDS dominance tree walk, including duplication simulation, to enable constant folding optimizations of addition instructions.

At 100%, we will implement constant folding for more arithmetic instructions, as well as adding support for strength reduction and read elimination optimizations.

At 125%, we will add support for heuristically analyzing if the optimization opportunities are worthwhile as outlined in the paper, as well as the conditional elimination optimization.

Schedule

All work will be shared via pair programming.

Week	
3/21	Work on Dominance tree walk
3/28	Work on Duplication Simulation Traversal step
4/4	Finish Duplication Simulation, begin Optimization simulation for constant folding
4/11	Finish Constant Folding for addition and other operations
4/18	Implement strength reduction
4/25	Implement read elimination

Milestone

By the milestone, we hope to have completed the 75% goal of having the DBDS framework working, with constant folding of addition as our “canary” optimization.

Literature Search

The main paper we need is “Dominance-Based Duplication Simulation (DBDS)” (https://dl.acm.org/doi/pdf/10.1145/3168811), which describes the optimization pass we are writing.

The only resource that we might want in the future is a resource on Conditional Elimination. The DBDS paper does not describe how this optimization works, so if we want to reach our 125% goal we will need a source for how to implement this.

Resources Needed

We will be using the LLVM compiler framework on VirtualBox to implement our optimization passes.

Getting Started

We have thoroughly read the DBDS paper, written this document, and discussed our approach to this problem. We also set up a Github Pages website to track the progress of this project. We do not currently have anything blocking us starting work on the project.