GVN-Hoist: Hoisting Computations from Branches

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GVN-Hoist: Hoisting Computations from Branches

- identifies identical computations in a function
- hoist identical computations to a common dominator
- reduces code size
- reduces critical path lenth by exposing more ILP

Example of hoisting

```
if (inv >= 0) {
  tmin = (min - a) * inv;
  tmax = (max - a) * inv;
} else {
  tmin = (max - a) * inv;
  tmax = (min - a) * inv;
}
```

```
x = (min - a) * inv;
y = (max - a) * inv;
if (inv >= 0) {
  tmin = x;
  tmax = y;
} else {
  tmin = y;
  tmax = x;
}
```

Optimistic GVN-hoist Algorithm

- compute value number of scalars, loads, stores, calls
- compute insertion points of each type of instructions
- hoist expressions and propagate changes by updating SSA

GVN-Hoist: Algorithm-collecting value numbers

- scalars: use the existing GVN infrastructure
- loads: VN the pointer operand
- stores: VN the pointer operand and the value being stored
- calls: as stores, loads, or scalars (following side effects)

current GVN not accurate for loads and stores: use ad-hoc change

GVN-Hoist: Algorithm-compute insertion points

Insertion Point: A location where all the operands are either available or, can be made available.

- Compute a common insertion point for a set of instructions having the same GVN (Similar to VBEs but not as strict)
- Partition the candidates into a smaller set of hoistable candidates when no common insertion points can be found

GVN-Hoist: Algorithm-hoist expressions

- scalars: just move one of the instructions to the hoisting point and remove others; update SSA
- loads and stores: try to make geps available, then hoist; update SSA and memory SSA

Cost models

- limit the number of basic blocks in the path between initial position and the hoisting point
- limit the number of instructions between the initial position and the beginning of its basic block
- do not hoist GEPs
- limit the number of dependent instructions to be hoisted

CFGSimplify's code hoisting

- hoists computations at the beginning of BB
- stops at first difference
- very fast: disabling slows the compiler: 1688 $\rightarrow$ 1692 Bn insns

GVN hoisting

- 1% compile time overhead: 1678 $\rightarrow$ 1692 Bn insns
- more hoists than CFG-simplify: 15048 $\rightarrow$ 25318

Scalars hoisted	8960
Scalars removed	11940
Loads hoisted	16301
Loads removed	22690
Stores hoisted	50
Stores removed	50
Calls hoisted	7
Calls removed	7
Total Instructions hoisted	25318
Total Instructions removed	34687

Code size reduction

Code-size metric (.text)	Number
Total benchmarks	497
Total gained in size	39
Total decrease in size	58
Median decrease in size	2.9%
Median increase in size	2.4%