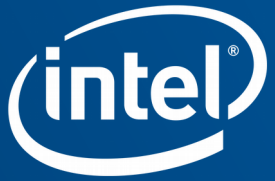

Value Range Tracking in NIR

Ian Romanick – X.org Developers Conference 2018 (Lightning Talk)

Overview

- Existing “0^{th}-order” tracking
- WIP 1^{st}-order tracking
- Existing 2^{nd}-order tracking
- Future 2^{nd}-order tracking

Existing 0^{th}-order tracking

Rely on known range produced by certain operations

```
(('fabs', ('b2f', a)), ('b2f', a))
```

WIP 1st-order tracking

Gather information about SSA values based on known properties of operation results.

- Analysis conceptually similar to existing 0th-order
  - Result of fabs must be ≥ 0, etc.
  - (value ≥ 0) * (value ≤ 0) → result must be ≤ 0
  - Analysis is on demand, but results are cached.
- Add simple predicates for use in nir_opt_algebraic

```
(('fge', 'b(is_not_negative)', 'a(is_not_positive)'), True)
```

WIP 1st-order tracking

Results so far are good

- Two main commits:
  - nir: Use value range analysis to eliminate tautological compares
  - nir: Use value range analysis to convert a fmin to an fsat

```
total instructions in shared programs: 15088355 -> 15027041 (-0.41%)
instructions in affected programs: 2823740 -> 2762426 (-2.17%)
helped: 10614
HURT: 2
helped stats (abs) min: 1 max: 294 x̄: 5.78 x̃: 2
helped stats (rel) min: 0.05% max: 58.33% x̄: 3.23% x̃: 1.37%
HURT stats (abs)   min: 6 max: 6 x̄: 6.00 x̃: 6
HURT stats (rel)   min: 0.30% max: 0.30% x̄: 0.30% x̃: 0.30%
95% mean confidence interval for instructions value: -5.99 -5.56
95% mean confidence interval for instructions %-change: -3.32% -3.15%
Instructions are helped.
```

Existing 2nd-order tracking

Tim Arceri's recently did some work to propagate compare results into branches.

Future 2nd-order tracking

Infer value ranges from if-statement conditions, loop conditions, etc.

- Add NIR instructions similar to clang's / MSVC's "assume" built-in.
  - ssa_4 = assume_gt ssa_3, 0
  - Could expose directly in GLSL / SPIR-V
- Allows tracking of ranges after if-statements are replaced with bcsel
- Interferes with copy prop, CSE, etc.
  - Run optimization loop, strip assume instructions, run loop again?
- Or – hash values based on SSA and block ID
  - Harder to deal with bcsel

Questions?

https://cgit.freedesktop.org/~idr/mesa/log/?h=simple-range-analysis


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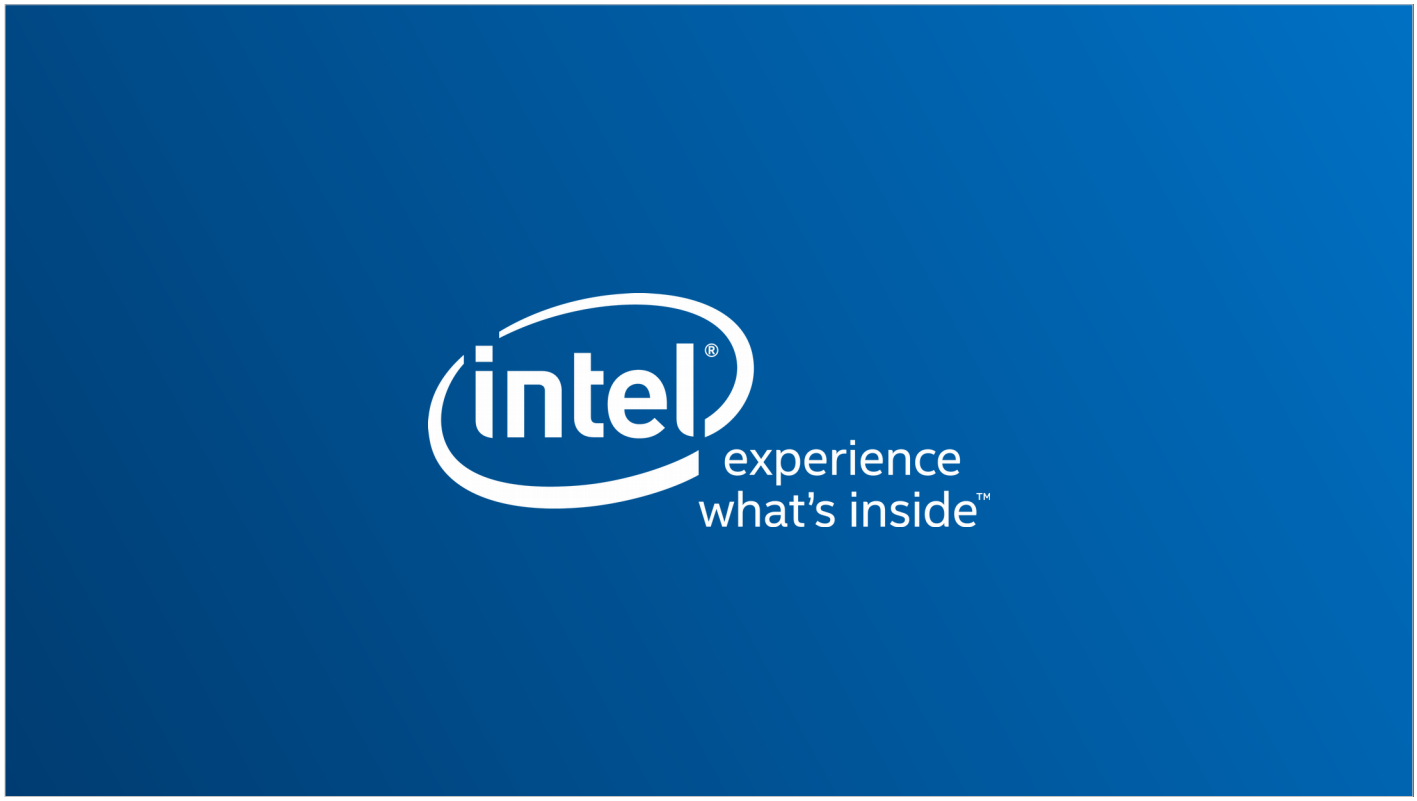
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