

# Status of High Level Loop Optimizations in GCC

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Jul. 9th, 2012

# Not so high-level loop optimizations

Work on innermost loops or at least do not consider a loop nest as whole.

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- loop header copying
- final value replacement
- complete loop peeling
- loop invariant motion and store sinking
- loop unswitching
- loop distribution and pattern detection
- loop if-conversion
- loop vectorization
- predictive commoning
- loop induction variable optimization
- loop array prefetching
- loop unrolling and peeling

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Memory hierarchy optimization.

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- loop strip mining
- loop blocking
- loop interchange
- unroll and jam
- working interchange
- better heuristics for complete loop nest unrolling

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- Alongside the regular
- Track individual loops throughout the entire compilation
- Attach information
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- When to do (highlevel) loop transforms?
- Cost model issues
  - Too many tiny scalar optimization passes in random order
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# GRAPHITE

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# GRAPHITE pros

- Almost all high level loop optimizations implemented in the GRAPHITE framework
- The polyhedral model is well researched and other compilers use it
- No phase-ordering issues(?)
- GRAPHITE has been updated to work with ISL instead of PPL and with a recent CLoG version
- Possibly using shared infrastructure between GCC and LLVM (Polly)

# GRAPHITE cons

- The GCC side of GRAPHITE is still considered unmaintained due to lack of resources
- Polyhedral optimizations are slow and memory-hungry
- Discourages work on non-GRAPHITE high level loop optimizers?

# Alternatives

- Re-surrect the old interchange code?
- Middle-end array expressions?
- Other suitable representation for high-level loop optimizations?
- Simply throw away GRAPHITE first?
- Volunteers?



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# Discussion

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