Research on CAT

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From our class to the state-of-the-art

• Improvements

• Value-based CAT

• Empirical model-based CAT

• Specialized CAT

• Better compiler structures

• Better IRs
Improvements of our algorithms

• Alias analysis with
  • higher accuracy
  • Faster
  • Less memory consumption

• Better heuristics for
  • When to inline
  • When to unroll/peel/etc...
  • When to apply transformation X

• Better inter-procedural CAT
  • Better summary nodes
  • Better contexts
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Value-based CAT

• Static value range CAT

• Profile-guided CAT
  • Use training inputs

• Dynamic CAT
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Empirical model-based CAT

• Autotuner
  • Typically: heuristic drives the CATs
  • Instead: use ML-based techniques to generate the model that drives the CATs

• Superoptimizers
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Specialized CAT

• Domain-specific CAT

• Hardware-specific CAT
  • Parallelism extractions

• Programming language-specific CAT

• Hardware-software co-designed CAT
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Better compiler structures

• Better compiler constructions
  • LTO
  • Better PassManager
  • Lifelong CATs
  • Collaborative design

• Certifying compilers

• Human in the loop
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IRs

• An IR dictates which CATs are easy/accurate to implement and which ones aren’t

• Different CATs prefer different IRs

• Can we have a single IR to dominate them all? Unlikely
  • So we likely need multiple IRs

• How do we organize them?

• Which IRs should we have?
  • What are the aspects that are important for different families of CATs?
Example of research related to IR

• MLIR

• HPVM

• MemOIR
Are you interested?

Advanced
Talk to me (independent studies/projects)

Topics
in
Compilers
Always have faith in your ability

Success will come your way eventually

Best of luck!