

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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- **Better IRs**

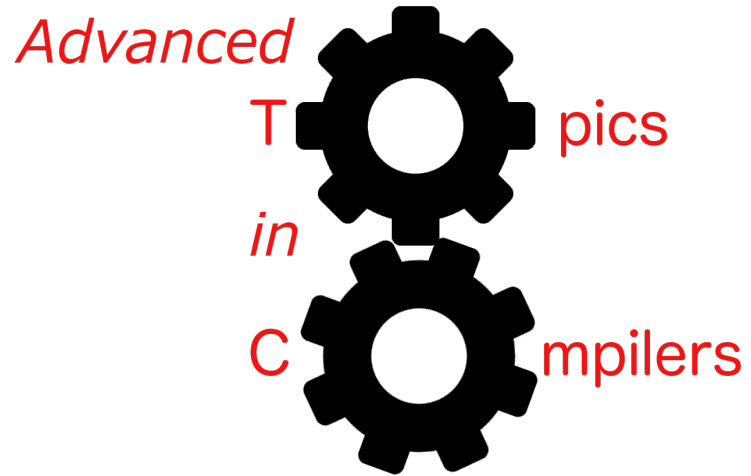
IRs

- 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?



Talk to me (independent studies/projects)

Always have faith in your ability

Success will come your way eventually

Best of luck!