PlayStation

Interprocedural IR Outlining For Code Size

River Riddle

Sony Interactive Entertainment - Tools & Technology

Why?

- Code Size is Important
  - Embedded Systems!
- Outlining is Low Hanging Fruit

Outlining For Code Size

Reduce code size by finding common code sequences and extracting them to separate functions.

- Easy Examples:
  - Function calls with constant parameters.
    - fprintf(stderr, “some msg”);
    - Error handling, memory allocation, intrinsics, API calls, etc.
  - Macros
  - Templates
  - Inline Functions

Outlining at the IR Level

- Value Number based on Semantic Equivalence
  - “Is this the same operation?” vs “Does this compute the same value?”
- Common Substring Query
- Candidate Analysis & Optimization
  - Parameterize the different values used.
- Cost Modeling
- Pruning & Outlining

```
  %17 = tail call i32 @strcmp(i8* %11, i8* %6)
  %18 = icmp eq i32 %17, 0
....
  %33 = tail call i32 @strcmp(i8* %22, i8* %4)
  %34 = icmp eq i32 %33, 0
```

```
%17 = outlinedFn(i8* %11, i8* %6)
....
%33 = outlinedFn(i8* %22, i8* %4)

define i1 @outlinedFn(i8*, i8*) {
  %3 = tail call i32 @strcmp(i8* %0, i8* %1)
  %4 = icmp eq i32 %3, 0
  ret i1 %4
}
```

Choosing IR over Machine Level

Con - Inaccurate Cost Model

- Instructions folded during lowering
- Cost Visibility
  - May be additional cost that is only visible when lowering.
  - E.g global addressing, int imm., parameter passing.

Pros

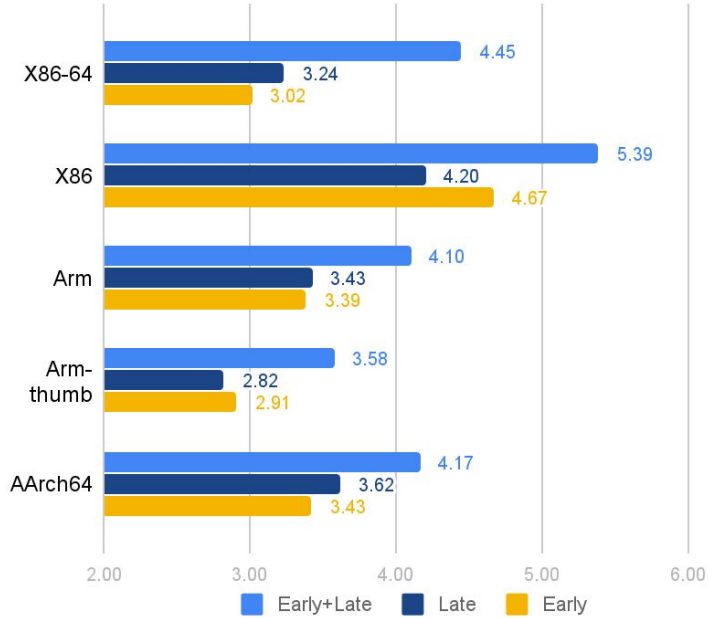
- More Opportunity
  - Less noise, Less restrictive equivalence.
- Pipeline Flexibility
- Target Independent

Performance

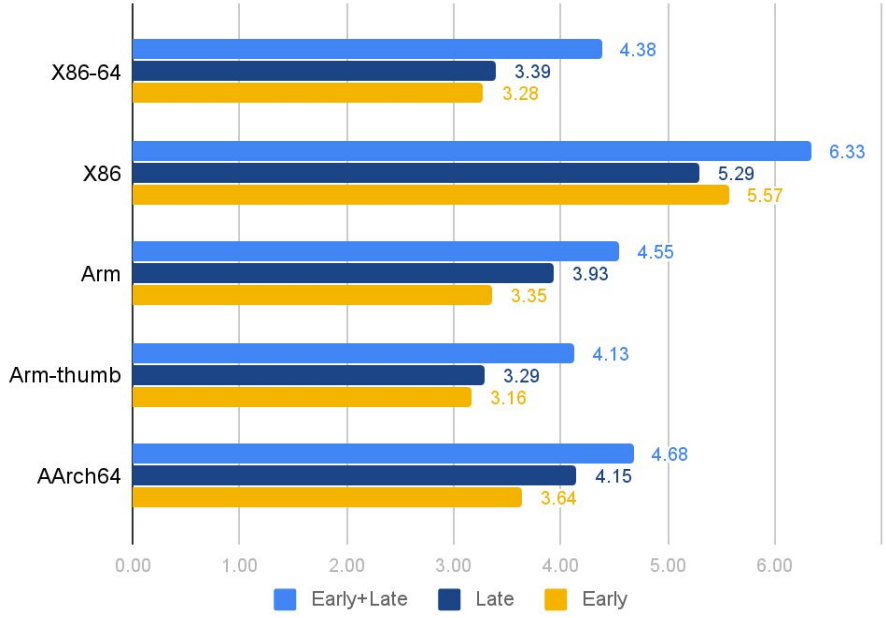
Improvement over Clang Oz

* Early - Pre Inlining. * Late - Pre ISel

Spec 2006 Code Size % Geomean Improvement



Spec 2006 Code Size % Total Size Reduction



Outlining the Future

- Different Outlining Methods
  - Existing
    - Post RA Machine Level
      - Currently available in-tree for X64, AArch64
    - IR Level
  - Future?
    - Pre RA Machine Level
    - Region based

- Abstracting Shared Logic
  - Utilities: Candidate Selection, Pruning, etc.
  - Relaxed equivalency analysis is mostly IR agnostic.

More Info

RFC 1: http://lists.llvm.org/pipermail/llvm-dev/2017-July/115666.html
RFC 2: http://lists.llvm.org/pipermail/llvm-dev/2017-September/117153.html
Full Performance: https://goo.gl/ZBjHCG

PlayStation

Thank You!