Lecture 6

CIS 341: COMPILERS

Announcements

- HW2: X86lite
  - Due: Weds, February 7th at 11:59:59pm
  - Pair-programming:
    - Register the group on the submission page
    - Submission by any group member counts for the group

see: ir-by-hand.ml, ir<X>.ml

INTERMEDIATE REPRESENTATIONS

Eliminating Nested Expressions

- Fundamental problem:
  - Compiling complex & nested expression forms to simple operations.

Source

```
((1 + X4) + (3 + (X1 * 5)))
```

AST

```
Add(Add(Const 1, Var X4),
    Add(Const 3, Mul(Var X1,
                     Const 5)))
```

IR

?

- Idea: *name* intermediate values, make order of evaluation explicit.
  - No nested operations.

Translation to SLL

- Given this:

```
Add(Add(Const 1, Var X4),
    Add(Const 3, Mul(Var X1,
                     Const 5)))
```

- Translate to this desired SLL form:

```
let tmp0 = add 1L varX4 in
let tmp1 = mul varX1 5L in
let tmp2 = add 3L tmp1 in
let tmp3 = add tmp0 tmp2 in
  tmp3
```

- Translation makes the order of evaluation explicit.
- Names intermediate values
- Note: introduced temporaries are never modified

Intermediate Representations

- IR1: Expressions
  - simple arithmetic expressions, immutable global variables
- IR2: Commands
  - global *mutable* variables
  - commands for update and sequencing
- IR3: Local control flow
  - conditional commands & while loops
  - *basic blocks*
- IR4: Procedures (top-level functions)
  - local state
  - call stack

Basic Blocks

- A sequence of instructions that is always executed starting at the first instruction and always exits at the last instruction.
  - Starts with a label that names the *entry point* of the basic block.
  - Ends with a control-flow instruction (e.g. branch or return) the "link"
  - Contains no other control-flow instructions
  - Contains no interior label used as a jump target

- Basic blocks can be arranged into a *control-flow graph*
  - Nodes are basic blocks
  - There is a directed edge from node A to node B if the control flow instruction at the end of basic block A might jump to the label of basic block B.