

Plan for today

Finish instruction selection for x86

Register allocation

- spill all
- possible improvements over spill all

CS453 Lecture

x86 code gen and register allocation

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Instruction selection for x86

Registers

- | | |
|-----------------------------|----------------------------------|
| - EAX, the accumulator | •ESI, the source register |
| - EBX, the base register | •EDI, the destination register |
| - ECX, the counter register | •ESP, the stack pointer register |
| - EDX, the data register | •EBP, the frame pointer register |

Representations

- Constants prefixed with '\$', for example \$3, \$4, \$-5, etc
- Registers prefixed with '%', for example %eax, %esp, etc.

Some Instructions

- | | |
|------------------------|--------------------------------------|
| - movl -12(%ebp), %eax | // M[%ebp-12] --> %eax |
| - imull -4(%ebp), %eax | // M[%ebp-4] * %eax --> %eax |
| - cmpl -4(%ebp), %eax | |
| - jge .L2 | // if (M[%ebp-4] >= %eax) goto .L2 |

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Temps as destinations and sources

Destination (or Temp defines)

- in Translate to IR Trees
 - pointer to class instance created by NewExp
 - pointer to start of allocated array
 - array length is defined
 - result of function call
 - holds 0 or 1 to indicate result of a less than
- in CodeGen
 - a Temp holds the result of each expression evaluation

Source (or Temp used)

- in Translate, a Temp is used in Tree.Syms generated for some AST node where Temp is defined
- in Translate, false body must come after Stmt.JUMP, but exit doesn't necessarily have to come after either (POSSIBLE PROBLEM)
- in CodeGen, when generating code for a parent node, Temps defined in the children nodes are often used

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Possible approaches for improving over spill all

Linear pass over the Astree.Instrs

- after spill all, remove loads from rw-lw pairs where the temp and frame location are the same:

```
eg.      rw $t2, -16($fp)
         lw $t2, -16($fp)
```

- before spill all, assign each Temp to a callee-saved register until run out

```
eg.      $t4    -->   frame.RA
         $t5    -->   frame.R0
         ...
         calleeSaves = ( RA, R0, R1, R2, R3, R4, R5, R6, R7)
```

- after spill all, assign each frame location to a callee-saved register until run out

```
eg.      $fp-12 -->   frame.RA
         $fp-16 -->   frame.R0
         ...
         calleeSaves = ( RA, R0, R1, R2, R3, R4, R5, R6, R7)
```

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Example

```
.text
la_start:
la_start_framesize=100
la_start_paramsregsave=16
```

- the above function has $(100-16)/4$ locals and temps, 21 locals and temps:

```
.text
la_search:
la_search_framesize=224
la_search_paramsregsave=16
```

- the above function has $(224-16)/4$ locals and temps, 52 locals and temps: