CSE443
Compilers

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http://www.cse.buffalo.edu/faculty/alphonce/SP17/CSE443/index.php
https://piazza.com/class/iybn4ndqa1s3ei
Project status

- Where are teams at with the project?
- Where are individuals at with the HW?
Project due date

- Wednesday March 14 @ 5:00 PM
- Homework 2 also due W @ 5.
Example from last class

S -> while ( { L1 = new (); L2 = new();
               C.false = S.next; C.true = L2; } )

C ) { S1.next = L1; }

S1 { S.code = label || L1 || C.code ||
       label || L2 || S1.code; }
Example from last class

\[ S \rightarrow \text{while ( } M \text{ C ) } N \]

\[ S1 \{ S.\text{code} = \text{label } || \text{L1 } || C.\text{code } || \text{label } || \text{L2 } || S1.\text{code}; \} \]

\[ M \rightarrow \epsilon \{ \text{L1 = new (); L2 = new(); C.false = S.next; C.true = L2; } \} \]

\[ N \rightarrow \epsilon \{ S1.\text{next} = \text{L1}; \} \]
Phases of a compiler

Intermediate Representation (IR): specification and generation

Figure 1.6, page 5 of text
IR

machine independent optimizations

machine dependent optimizations

target 1

target 2

... 

target n
HLL

PROJECT 3

IR

PROJECT 4

PROJECT 5

target 1

machine independent optimizations
Intermediate Representations
Directed Acyclic Graph (DAG)

- Similar to a syntax tree
- No repeated nodes: structure sharing
Ex. 6.1 [p 359]

\[ a + a \times (b - c) + (b - c) \times d \]
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\[ a + a \times (b - c) + (b - c) \times d \]
Ex. 6.1 [p 359]

\[ a + a \times (b - c) + (b - c) \times d \]

Things can be more complicated if expressions have side effects
Value-number method
Algorithm 6.3 [p. 361]

- **Input:** label op, node l, node r

- **Output:** The value number of a node in the array with signature \(<op,l,r>\)

- **Method:** Search the array for a node M with signature \(<op,l,r>\). If there is such a node, return the value number of M. If not, create in the array a new node N with signature \(<op,l,r>\) and return its value number.
Revisiting 6.1
see construction steps in figure 6.5 [p. 360]

<p>| | | | |</p>
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<td>1</td>
<td>id</td>
<td></td>
<td>$\rightarrow$ to ST entry for a</td>
</tr>
<tr>
<td>2</td>
<td>id</td>
<td></td>
<td>$\rightarrow$ to ST entry for b</td>
</tr>
<tr>
<td>3</td>
<td>id</td>
<td></td>
<td>$\rightarrow$ to ST entry for c</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>2</td>
<td>3</td>
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<tr>
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<td>8</td>
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</tbody>
</table>
Three address code representation

\[ t_1 = b - c \]
\[ t_2 = a \times t_1 \]
\[ t_3 = a + t_2 \]
\[ t_4 = t_1 \times d \]
\[ t_5 = t_3 - t_4 \]