CS3005D Compiler Design

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Lecture #27

Translation of flow-of control statements

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Grammar

$S \rightarrow \textbf{if}\ (B)\ S \mid \textbf{if}\ (B)\ S\ \textbf{else}\ S \mid \textbf{while}\ (B)\ S$

$B \rightarrow B||B \mid B\&\&B \mid !B \mid (B) \mid E\ \textbf{relop}\ E \mid \textbf{true} \mid \textbf{false}$

if-else statement

Semantics of *if* (B) S_1 *else* S_2

if B evaluates to *true*, transfer control to S_1

if B evaluates to *false*, transfer control to S_2

The generated code should consists of code for B, followed by code for S_1, then code for S_2, with *goto* statement inserted at appropriate places according to the semantics.

Translation of *if-else* statement: example

if $(a < b)$ *small* $=$ *a else small* $=$ *b*

$$
\begin{aligned}
&\textit{if } a < b \textit{ goto } L_1\\
&\textit{goto } L_2\\
L_1:\ &\textit{small}{=}a\\
&\textit{goto } L_3\\
L_2:\ &\textit{small}{=}b\\
L_3:\ &
\end{aligned}
$$

Translation of Boolean Expressions[1]

Production	Semantic Rules
$B \rightarrow E_1$ **relop** E_2	$B.code = E_1.code \mid\mid E_2.code \mid\mid$ $gen('if'\ E_1.addr\ relop.op\ E_2.addr\ 'goto'\ B.true)$ $gen('goto'\ B.false)$
$B \rightarrow$ **true**	$B.code = gen('goto'\ B.true)$
$B \rightarrow$ **false**	$B.code = gen('goto'\ B.false)$

$B.true$: label of the 3-address instruction to which control should transfer if B evaluates to true
$B.false$: label of the 3-address instruction to which control should transfer if B evaluates to false

[1] occurring in conditional control constructs

Translation of *if-else* statement

Production	Semantic Rules
$S \rightarrow$ *if* (B) S_1 *else* S_2	$B.true = newLabel()$ $B.false = newLabel()$ $S_1.next = S_2.next = S.next$ $S.code = B.code \mid\mid label(B.true)$ $\mid\mid S_1.code \mid\mid gen('goto'\ S.next)$ $\mid\mid label(B.false) \mid\mid S_2.code$

newLabel(): creates and returns a new label in each invocation

label(L): attaches label L to the next 3-address instruction

$S.next$ (inherited attribute): address (label) of instruction immediately following S

Translation of *if* statement

Production	Semantic Rules
$S \rightarrow \ if\ (B)\ S_1$	$B.true = newLabel()$
	$B.false = S_1.next = S.next$
	$S.code = B.code \mid\mid label(B.true) \mid\mid S_1.code$

Exercise

Write the 3-address code generated for the following instructions, as per the given SDD:

$$if\ (x < y)\ small = x\ else\ small = y$$
$$if\ (true)\ small = x\ else\ small = y$$

References

References:

- Aho A.V., Lam M.S., Sethi R., and Ullman J.D. Compilers: Principles, Techniques, and Tools (ALSU). Pearson Education, 2007.

Further reading:

- ALSU Section 6.6